General

John

Los Alamos
NATIONAL LABORATORY

Memorandum

Risk Reduction & Environmental Stewardship (RRES)
Groundwater Protection Program (GPP), MS M992

To/MS: Distribution
From/MS: Charles Nylander, RRES-GPP, MS M992
Phone/FAX: 7-8285/5-4747
Symbol: RRES-GPP-03-013
Date: February 3, 2003

Charles Nylander

SUBJECT: MINUTES FROM THE HYDROGEOLOGIC CHARACTERIZATION PROGRAM QUARTERLY MEETING HELD JANUARY 22, 2003

Enclosed please find the minutes from Los Alamos National Laboratory's (LANL) Hydrogeologic Characterization Program Quarterly Meeting held January 22, 2003. The discussions and presentations at the meeting resulted in the following highlights:

- There is significant funding uncertainty for FY03. The Laboratory is operating under continuing resolution, which allows spending at FY02 levels.
- The current level of funding is only sufficient to complete the construction, reporting, site restoration, and sampling for the wells drilled in FY02.
- If additional funding should become available in FY03, the highest priority data needs will be discussed with New Mexico Environmental Department (NMED).
- The External Advisory Group has prepared a report with their observations and recommendations from the October 29-31 2002 meeting and that report will be distributed to the mailing list next week.
- NMED data will be available in the WQDB in the next quarter.
- The well completion reports for the five FY02 wells will be distributed when they are completed, but all are expected to be completed by March 31, 2003. The well is considered complete when it is surveyed. The date of survey of each well is provided on the well completion fact sheets.
- The document(s) that will include the interpretative information that was previously provided in Part II of the well completion reports will be determined and announced at the Annual Meeting in March.
- NMED will be consulted about plans to plug and abandon Mortandad Canyon intermediate well MCOBT-4.4.
- The draft Groundwater Annual Status Report will be mailed out for review and comment at the end of this month.
- During the PM-2 pumping test, the water will be sample at least once, and if money is available, will be sampled more frequently.
- When the schedule for drilling R-2 and R-4 is known, Los Alamos County will be consulted to develop a plan for traffic in Pueblo Canyon.
- The Annual Meeting for the Hydrogeologic Characterization Program will occur March 18-19, 2003 in Santa Fe.

Please review these minutes for accuracy. If you identify substantive changes that should be made, please submit your comments to me in writing or via e-mail at nylander@lanl.gov.

Enclosure: External Advisory Group's Semi-Annual Report for October 2002
Minutes from the Hydrogeologic Characterization Program Quarterly Meeting

CN/th

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J. Aldrich, EES-6, MS D462
D. Broxton, EES-6, MS J462
G. Cole, EES-6, MS D462
F. Goff, EES-6, MS D462
D. Hickmott, EES-6, MS D462
P. Longmire, EES-6, MS D469
D. Vaniman, EES-6, MS D462
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B. Robinson, EES-6, MS T003
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E. Springer, EES-15, MS J495
B. Newman, EES-15, MS J495
A. Gallegos, EES-15, MS J495
C. LaDelfe, EES-11, MS D462
P. Stauffer, EES-6, MS T003
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S. Kinkead, IM-8, MS M310
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N. Quintana, RRES-R, MS 992
S. Natalie, PM-PPC, MS M992
R. Koch, SAIC, MS J521
RRES-RPF, MS M707, (ER2003-0104)
GPP File, MS M992
IM-5, MS A150

Los Alamos National Laboratory
Hydrogeologic Characterization Program
Quarterly Meeting
January 22, 2003
Minutes

MEETING PURPOSE, ATTENDEES, AND AGENDA

The Los Alamos National Laboratory Groundwater Integration Team (LANL GIT) met with the New Mexico Environment Department (NMED), the Department of Energy (DOE), and stakeholders on January 22, 2003 for the Quarterly Hydrogeologic Characterization Meeting. The meeting was held at the Pueblo of Pojoaque Cities f Gold Hotel in Pojoaque, New Mexico. Charlie Nylander (GIT Chairperson) facilitated the meeting.

The following groups and stakeholders were represented (see List of Attendees for specific information):

- NMED-Hazardous and Radioactive Materials Bureau
- NMED-DOE Oversight Bureau
- New Mexico Attorney General
- DOE-Office of Los Alamos Operations
- DOE-Northern New Mexico Citizen's Advisory Board
- Concerned Citizens for Nuclear Safety
- University of California
- LANL-Groundwater Integration Team (GIT)

The purpose of the Quarterly Meeting was to provide NMED, DOE, and stakeholders with information regarding LANL's groundwater protection efforts and to present activities planned for the upcoming fiscal year. The meeting agenda was as follows:

Introductions

Groundwater Integration Team (GIT) Subcommittee Status Reports
- Information Management
- Well Construction
- Geochemistry
- Modeling
- Hydrology

FY03 Planning Discussion: Proposed DQOs for FY03 wells

Groundwater Pathways Assessment

Discussion of Groundwater Pathways Assessment

Los Alamos National Laboratory
Hydrogeologic Characterization Program
Quarterly Meeting
January 22, 2003
Minutes

SUMMARY OF PRESENTATIONS AND DISCUSSIONS

Introduction

Charlie Nylander (LANL) welcomed the participants to the meeting and explained that the Los Alamos National Laboratory Hydrogeologic Characterization Program has conducted quarterly meetings since 1998. The quarterly meetings are a forum to review the status of the program and to encourage feedback, comments, and questions from regulators and interested parties. The Hydrogeologic Characterization annual meeting will be held in March. The annual meeting is a longer meeting with more extensive technical presentations. The last quarterly meeting, in October, was held in conjunction with the External Advisory Group semi-annual review. The External Advisory Group has prepared a report with their observations and recommendations. The report will be distributed to the mailing list next week.

Groundwater Integration Team Subcommittee Status Reports

Information Management Subcommittee Status

Sue Kinkead (LANL) reported that the Water Quality Database (WQDB) is completely functional. Over the last quarter the focus has been on getting data into the database. The exchange of chemistry data between the Environmental Restoration Database (ERDB) and the WQDB is up and running well. The current challenge is developing the exchange with non-LANL organizations, particularly the New Mexico Environment Department (NMED). The goal of the WQDB is to be the single, integrated source of groundwater data.

The most recent exchange of chemistry data between the ERDB and WQDB took place in December and January. That data will be available to external users next week. The subcommittee established a regular schedule for data exchange and scheduled a regular joint ERDB/WQDB meeting to discuss and resolve issues.

Transferring NMED data into the WQDB involved identifying the pertinent NMED data. The next step is to resolve the data format issues that arise from transferring data from the NMED Microsoft Access database to the WQDB. The format issues are expected to be resolved soon, and NMED data is expected to be available in the WQDB in the next quarter.

Well construction data is included in the WQDB. Prior to the last 6 wells, the well construction data were generated by ER Project personnel, entered in the ERDB, and transferred to the WQDB. The data entry for well construction data is transitioning to direct entry into the WQDB. The transition requires establishing procedures for quality review and identifying and training personnel.

Water level data is also included in the WQDB. Previously, including water level data has required data entry for individual wells in different data formats. This quarter a standard file format for water level data was developed, and the programming to enter the data from the standard format was completed.

Also during the quarter a web interface for data verification and validation was developed. Data verification and validation has previously been accomplished on hard copies of lab reports outside the WQDB. The programming to accomplish verification and validation online will streamline the process. The completed program will add a QA function requiring that a second person must check the work of the validator before the data will be accepted into the database.

Looking ahead to next quarter, the information management subcommittee expects to complete final Phase I development that includes spiked sample tracking, upgrading the electronic data deliverable parser, and invoice tracking. Currently, spiked samples are sent to the analytical laboratories, but the results are only tracked on paper copies. When Phase I is complete, results of the spiked sample analyses will be tracked by the WQDB.

Information Management Question and Answer:
Question: How much of the data has a QA/QC check?
Answer: 100% of the data has QA/QC check.

Question: What are the major roadblocks to exchanging data with the NMED?
Answer: LANL resources – the data manager is on maternity leave. However, we have identified a strategy and the requirements and we believe this will be accomplished in the next quarter.

Question: Are the well construction data for all the R-wells in the WQDB?
Answer: The well construction data for the 12 wells completed prior to the summer of FY02 are in the WQDB. The FY02 well construction data is being directly entered into the WQDB.

Question: The NMED/OB data is already in the WQDB, but there is no way to distinguish it from LANL data.
Answer: The data was previously imported from NMED/OB into a legacy database system that does not show the source of the data. The data that will be imported using the new programming will show the source of the data.

Well Construction Subcommittee Status
John McCann (LANL) reported that the work this quarter is focused on completing wells R-14, R-16, R-20, R-23, and R-32. A summary of the FY02 wells follows.

R-14

- Completed final development and collection of baseline groundwater samples from each screened interval
- Removed a total of 205,010 gallons of groundwater during development
- Completed hydrological testing
- Installed Westbay sampling system with two ports

R-32

- Completed final development and collection of baseline groundwater samples from each screened interval
- Removed a total of 144,670 gallons of groundwater during development
- Completed hydrological testing
- Installed Westbay sampling system with three ports

R-20

- Obtained core from offset boring from 75 to 416 ft
- Completed final development and collection of baseline groundwater samples from each screened interval

- Removed a total of 113,070 gallons of groundwater during development
- Completed hydrological testing

R-23

- Completed successful backfill operations on well; single screen completion
- Performed well development, removing a total of 25,900 gallons of groundwater to date

R-21

- Drilled last quarter by DOE contractor with some support by LANL
- Completed hydrologic testing last week
- Expect completion report next week
- Will begin sampling next quarter

The introduction of drilling methods requiring the use of fluids presented challenges for well development. Removal of the fluids following completion of drilling required pumping a large volume of water out f the wells and increasing the yield of the wells. Circulation was lost in portions of the boreholes, requiring addition of lost circulation materials. Removal of these materials required pumping and the use of chemical dispersants. Developing multiple screen wells was also challenging. Developing five wells at the same time required logistical coordination. All development activities are complete. Current activities involve waste management, mostly the disposal of cuttings. The cuttings are removed from the cuttings pit and used in the site restoration, pending regulatory concurrence.

Two wells were sampled last quarter: CDV-R37-2 and R-13.

Reporting:

- Fact sheets for the FY02 wells are in the peer review comment resolution stage and are nearly complete.
- R-7 and R-22 geochemistry reports are going to printing this week.
- MCOBT-4.4 and MCOBT-8.5 well completion reports are also going to printing this week.
- Working on the well completion reports for the five FY02 wells. The reports are streamlined and do not include the Part II interpretative section. The reports will be distributed as they are completed. All are expected to be completed by March 31, 2003.

Well Construction Questions and Answers:
Question: When was each of the FY02 wells considered complete?
Answer: The well is considered complete when it is surveyed. The date of survey of each well is not available here, but can be provided.

Question: What is done with the water produced during development?
Answer: It is collected in frac tanks, sampled, and the samples analyzed. If the analytical results meet the "Notice of Intent to Discharge" specifications, the water is disposed of by discharge along fire roads.

Question: When will the well completion fact sheets be distributed?
Answer: We expect to distribute the well completion fact sheets soon.

Question: Where will the information that was previously in Part II of the well completion reports be published?

Answer: We expect to have that figured out by next quarter.

Question: What were the results of the pilot testing of the new Westbay pump on the purge ports?
Answer: The pump was tested on screen 5 (deepest screen) in R-22 this past summer. The test was intended to evaluate the functioning of the pump itself and the pump worked well; it was able to pump 9 L/hr. LANL collected before and after water quality data.

Geochemistry SubcommitteeStatus
Pat Longmire (LANL) said that the objective of the presentation is to present a summary of geochemical investigations conducted at LANL from April 2002 to January 2003.

Quarterly Groundwater (Characterization) Sampling
The wells, screened intervals and constituents of interest are shown in the following table:

Well	Screen Depths	Sampling Rounds
R-5	169 ft	1
	375 ft	
	678 ft	
	860 ft	
R-7	378 ft	4
	744 ft (dry)	
	915 ft	
R-8A	731 ft	0
	825 ft	
R-9	741 ft	4
R-9i	199 ft	4
	279 ft	
R-12	468 ft	4
	507 ft	
	811 ft	
R-13	940 ft	2
R-15	1019 ft	4
R-19	844 ft (dry)	4
	909 ft	
	1190 ft	
	1413 ft	
	1586 ft	
	1730 ft	
	1835 ft	
R-22	907 ft	4
	962 ft	
	1273 ft	
	1378 ft	
	1448 ft	
R-25	755 ft	4
	892 ft	
	1063 ft	
	1192 ft	
	1303 ft	
	1406 ft	

Well	Screen Depths	Sampling Rounds
	1605 ft	
	1796 ft	
R-31	454 ft	2
	532 ft	
	670 ft	
	831 ft	
	1011 ft	
MCOBT 4.4	524 ft	3
CdV-R-15	624 ft (dry)	8
	806 ft (dry)	
	968 ft (dry)	
	1254 ft	
	1350 ft	
	1640 ft	
CdV-R-37	927 ft	4
	1201 ft	
	1365 ft	
	1553 ft	

Post-characterization sampling was conducted at several wells during July and August 2002: R-22 (highest priority), R-25, R-15, R-9, R-9i, R-12, R-7, and R-19 (lowest priority). R-9 and R-15 will be sampled at a later date.

Groundwater Screening Samples from FY02 Wells
Groundwater screening samples were collected for analysis for a limited analytical suite from R-14, R-16, R-20, R-23, and R-32 prior to well construction. In Pajarito Canyon, no perchlorate was detected (4 µg/L detection limit) and there were low activities of tritium. In Ten Site Canyon at R-14, the perchlorate was less than detection, there was very little nitrate, and no contamination was detected in the regional aquifer. Additional samples will be collected for full analytical suites prior to hydrologic testing at these wells. Samples of core were collected from R-14, R-21, R-23, and R-32 and analyzed for anions, radionuclides, volatile organic compounds, and stable isotopes.

TA-16 Hydrological and Geochemical Investigations
The Geochemistry Team completed analysis of core for barium and several anions from 3 boreholes (about 160 feet deep). The objectives included evaluation of the vertical and lateral variability in site hydrology and possible contaminant distribution. The distribution of chloride suggests low downward fluxes and similar hydrologic behavior at both the east and west lobes of Material Disposal Area (MDA) P. Shallow barium contamination was observed in one borehole at a depth of less than 2 feet. Alluvial groundwater near the 260 outfall is characterized by reducing conditions that should enhance degradation of contaminants. Reducing conditions are characterized by decreasing concentrations of TNT, nitrate, and sulfate and increasing concentrations on of iron.

Summary of Constituents of Interest at MCOBT-4.4
MCOBT-4.4 is located in Mortandad Canyon, west of the sediment traps and below the confluence with Ten Site Canyon. The well has a pump intake in intermediate perched water at a depth of 524 feet in intermediate perched water. Three sets of samples have been collected from

MCOBT-4.4: an initial pre-characterization sample and two characterization samples. The analytical results were presented to the Northern New Mexico Citizens Advisory Board in the Fallfall. The validated analytical results of MCOBT-4.4 water samples collected in the two-characterization sampling rounds are shown in the following table:

Summary of Constituents of Interest Identified at MCOBT-4.4 (two characterization sampling rounds with validated data)			
Sampling Date	**Chemical**	**Concentration**	**Regulatory Limit**
4/22/02	Tritium	12,797 ± 1,368 pCi/L (3 σ)	MCL = 20,000 pCi/L
	Nitrate (N)	13.2 mg/L	MCL = 10 mg/L
	Perchlorate	142 µg/L	None
6/28/02	Tritium	14,600 ± 759 pCi/L (3 σ)	MCL = 20,000 pCi/L
	Tritium	14,900 ± 768 pCi/L (3 σ)	MCL = 20,000 pCi/L
	Nitrate (N)	12.5 mg/L	MCL = 10 mg/L
	Nitrate (N)	12.5 mg/L	MCL = 10 mg/L
	Perchlorate	178 µg/L	None
	Perchlorate	179 µg/L	None
	Tritium	14,900 ± 768 pCi/L (3 σ)	MCL = 20,000 pCi/L
	Nitrate (N)	12.5 mg/L	MCL = 10 mg/L
	Nitrate (N)	12.5 mg/L	MCL = 10 mg/L
	Perchlorate	178 µg/L	None
	Perchlorate	179 µg/L	None

The two samples collected on June 28 2002 show that the sample results are consistent between the two samples, the tritium number is the same within the error. The tritium and perchlorate increased, the nitrate decreased. Samples of core collected in R-15, MCOBT-4.4 and MCOBT-85. trackTrack the movement of nitrate and perchlorate in Mortandad Canyon.

Geochemistry Characterization Reports

- Geochemistry Characterization Reports for R-9 and R-9i, R-12, R-15, R-19, and R-22 have been provided to DOE as formal deliverables. The R-7 geochemistry report is in press.
- Geochemistry Characterization Reports provide information on analytical results for inorganic and organic chemicals and radionuclides measured during the four characterization sampling events
- Geochemical interpretation, including calculations, are provided in each report.

Geochemistry Question and Answer:
Question: The NMED had a concern about the placement of the screen in MCOBT-4.4 because of the uncertainty of where the water was coming from.
Answer: The water is coming from the Puye Formation and the Cerros del Rio basalt. To determine the source of the water, packers were placed in the well. and wWater came from the interval between 492 and 532 feet. The well is screened across stratigraphic intervals.

Question: What is the water level in MCOBT-4.4?
Answer: Initially the water level was at 492 ft and then it dropped to 532 feet. We are concerned about the drop in water level and are planning on plugging and abandoning the well and replacing

it with another well that is screened only in the upper section. We want to continue monitoring the water, but do not want it to continue to leak into deeper water bodies.

Question: Is there water level data from testing?
Answer: Yes.

Question: How long was the hole open during testing?
Answer: 3 –4 weeks

Question: Has MCOBT-4.4 been sampled since June?
Answer: It was sampled in September and will be sampled again in February.

Question: The newspaper said that the permeable reactive barrier is in, how can this be true with the pull back of fire money?
Answer: The barrier is being installed right now. The wings that funnel water through the barrier are being constructed.

Question: How is it being funded?
Answer: The money to finish the installation is available. However, a proposal will be prepared to get money for additional monitoring of the barrier.

Question: When the wells are transferred, after characterization sampling, are they transferred to stewardship or NNSA?
Answer: The wells will probably remain in operational NNSA, at least until the long-term environmental stewardship program is more firmly established. Funding has been requested from NNSA for monitoring and surveillance. The Groundwater Protection Program Is pulling all the wells together to manage as a group., all All the data will be available in the Water Quality database. All of the wells will be considered in designing an enhanced monitoring network.

Question: Did the analysis of samples in MCOBT-4.4 include strontium-90?
Answer: Yes, the samples were analyzed for the full suite, but I only reported the high values. There was no detection or of radionuclides or organics.

Question: Are the results reported at 2σ or 3σ?
Answer: The results are reported at 2σ, but most are nondetectable at 3σ.

Question: Have you considered using Sodium-22 as a tracer in alluvial water?
Answer: The nitrate with light isotopic signature is an excellent tracer because we know the time when it was released.

Question: If MCOBT-4.4 is plugged and abandoned, how will you consult with NMED? MCOBT-8.5 was plugged and abandoned without consulting NMED.
Answer: The well would be abandoned following state guidelines and the plan for plugging and abandoning will be discussed with NMED prior to implementation. There has been a lot of work focused on Mortandad Canyon: the treatment plant has been upgraded so that the effluent is clean with respect to nitrate and perchlorate. We salvaged money from the fire money cut to complete the installation of the permeable reactive barrier. We will be updating the work plan and conducting further investigation, subject to consultation with NMED. We are incorporating the results of the Groundwater Pathways Assessment. There were geophysical surveys of the canyon last summer and we may do more.

Question: When will the rest of the data for MCOBT-4.4 be released?

Answer: In a couple of weeks it should be available through the Water Quality Database.

Modeling Subcommittee Status

Bruce Robinson (LANL) reported that the groundwater modeling activities for the past quarter include groundwater modeling support of the integrated groundwater protection strategy with the component pieces of infiltration, vadose zone transport, and transport in the regional aquifer. In the previous quarter the regional aquifer modeling incorporated the new geologic models and presented initial calibration results. Currently there is continued model development and a big effort on communication.

Net Infiltration Study

The infiltration study was led by Ed Kwicklis and supported by Marc Witkowski, Kay Birdsell, Doug Walther, and Brent Newman. The objective was to develop a plateau-wide map of net infiltration for use in water resource and contaminant risk assessments. Net infiltration is defined as any water below the root zone that cannot be transpired or evaporated. Net infiltration becomes recharge and has the potential to carry contaminants. Development of the net infiltration map was a data-driven activity. The methodology was first to compile previously developed estimates of net infiltration, e.g., moisture profiles, chloride profiles, and stream flow loss. Second, to identify and map environmental variables that are likely to affect infiltration; e.g., topography, vegetation, soils, geology. Because it is not possible to have data for every point on the map, the net infiltration is estimated from environmental variables. Third, to extrapolate infiltration estimates from areas with data to areas without data based on the environmental variables. The current status of this activity is that a preliminary map has been developed and the work is under internal review.

Initial observations from the draft net infiltration map are:

- The range of net infiltration on the mesas of the Pajarito Plateau is on the order of 1 – 10 mm/yr
- The range of net infiltration on the mountains bounding the western edge of the Pajarito Plateau is on the order of 10 – 50 mm/yr
- Expect the net infiltration rate in wet canyons on the Pajarito Plateau to be higher, on the order of several hundred mm/yr
- The detail of the map is intended to support risk assessments

Vadose Zone and Regional Aquifer Modeling

Initial transport calculations are being prepared to predict transport of nitrate and perchlorate in Mortandad Canyon. Steps include source term estimates, infiltration estimates (from net infiltration map), vadose zone calculations of nitrate and perchlorate transport through one-dimensional vadose zone pathways, ongoing comparisons to moisture and contaminant profiles, and finally, simulations of regional aquifer transport taking vadose zone contaminant influxes as input. Work on this is in the draft stage; therefore quantitative results are not yet available.

Regional Aquifer Model: Ongoing Development

There is ongoing evaluation of the impact of recent data (water levels, stratigraphy, etc.) on model results. Work on capture zone analysis is continuing, with the addition of quantified uncertainty. Porosity estimates are being evaluated and refined by comparing simulated and measured carbon-14. Communicating the regional aquifer modeling has been a high priority. There have been two presentations at the American Geophysical Union annual meeting, summary sections in the Groundwater Annual Status Report for FY02, a draft high-level summary of the regional aquifer model that is in preparation, and meetings with stakeholders and other interested parties.

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Modeling Questions and Answers:
Question: Is the net infiltration map a conceptual or mathematical model?
Answer: It is a numerical representation of a conceptual model. It is not a precise measure of infiltration; it should not be used to look up the infiltration rate at any point on the Pajarito Plateau. It is a compilation of what we know and an initial guess at what the rate is in areas where we have no data.

Question: Will the net infiltration map be used only conceptually?
Answer: This is a scenario of how the net infiltration map would be used: the infiltration rate could be a deciding factor in prioritizing work on one site over another. Also, for investigations where it appears that the infiltration rate is important to decision-making, the map could be used to determine where better infiltration data are needed. It will be used both conceptually and numerically.

Question: Is it calibrated with recent data?
Answer: It is based on all available data and is "calibrated" to that data. The next step is to add uncertainty bounds to the map.

Question: How is the case of water that infiltrates but then re-emerges downstream handled.
Answer: That water would not fall under the definition of net infiltration, but there are definitely cases where that happens. Those cases point out why you can't just blindly take a point on the map, you have to consider what went into the map.

Question: Does the map show the actual data points?
Answer: The published report/map will have all the data sources.

Question: Will the report have the uncertainty ranges?
Answer: Yes, the report will include the uncertainty.

Question: What is the timeline for releasing the report?
Answer: The end of March.

Question: What about variations in precipitation on a yearly basis?
Answer: The map represents long-term average rates.

Question: Since the Cerro Grande fire there has been enhanced runoff and that may result in greater infiltration. How is that addressed in this work?
Answer: The goal was to produce a map of pre-fire conditions. We have to watch the system to assess whether the impact of the fire are short-term perturbations or long tem effects that have to be factored in.

Question: Will the wet canyon systems be modeled?
Answer: They will be modeled, but the degree of modeling will depend on the context of the decisions that need to be made with respect to contaminants. We are focusing on canyons where the data suggest that focus is necessary.

Question: Have you provided a list of data needs for canyon modeling to the data collection people?
Answer: We are always involved in the DQO process for the wells and, although there are compromises, we are not leaving out critical data.

Question: Since the source of contaminants in Mortandad Canyon has been shut off, what is known about degradation and natural attenuation?
Answer: There are really two source terms: what is being discharged to the canyon now and what was discharged historically that is now within the canyon system. The first source is shut off, but the second continues in the environment. We are trying to compile the data on what the historic sources are, but for some contaminants, specifically perchlorate, there are no records. We are trying to piece together the source term by looking at co-located contaminants, like nitrate, to estimate source terms. As far as degradation or attenuation, there is evidence in Mortandad Canyon that denitrification is occurring in the alluvial groundwater.

Hydrology Subcommittee Status
Bill Stone (LANL) presented an update on the hydrologic testing. A report has been prepared that describes the hydrologic testing of five wells: R-9i, R-13, R-19, R-22, and R-31. The report is in review now, and is expected to be available shortly.

The report includes:
- Well completion details and geology for each well
- Summary tables with the test design at the top, and results at the bottom for each well
- Data and the theoretical curve shown on the same plot
- Discussion along with each test to point out how well the test went and evaluate how good the data are
- Appendices with tabular and plotted data

In the future we will produce one report for each well, as it was complicated preparing a single report on multiple wells. The result is not as comprehensive a report as we would have liked, in terms of providing all the data.

Overview of Testing of FY02 Wells
Most aspects are the same as before: we will be testing with straddle-packer/injection tests. However, there are some changes: a different contractor means learning curves on the equipment (what, where) and methods (packers, flow, injection). Smaller rods require resolving issues such as compatibility with hoses and the impact on the delivery of water. There is a new protocol for testing. For each screen three different tests are conducted:

1. Injection at low rate for short time (minutes)
2. Injection at higher rate for the same amount of time as test 1
3. Injection at the same rate as test 2 for a long time (hours)

A summary of the tests completed on the FY02 wells is shown in the following table:

Well	Screen	Unit	Tests
R-14	1	Puye Formation	Two 1-minute injection
	2	Puye Formation	Two 1-minute injection
R-16	1	Puye Formation	Cased off
	2	Santa Fe Group	Two 1-minute injection & one 1-hour injection
	3	Santa Fe Group	Two 1-minute injection & one 1-hour injection
R-20	1	Cinder	Two 1-minute injection
	2	Puye Formation (Pumiceous)	Two 1-minute injection & one 1-hour injection

Well	Screen	Unit	Tests
	3	Totavi Lentil (?)	Two 1-minute injection & one 1-hour injection
R-23	1	Santa Fe Group	Pumping test scheduled
R-32	1	Gravel/basalt	Two 1-minute injection & one 1-hour injection
	2	Puye Formation	Pressure port
	3	Puye Formation	Two 1-minute injection & one 1-hour injection

Status of the PM-2 Pump Test
Steve McLin (LANL) described the status for the planning of a pumping test in PM-2 using R-20 and potentially R-32 as observation wells. The test is expected to start in about 10 days. PM-2 is a water supply well and the new FY02 wells present a great opportunity for a multi-well pump test. We expect to see drawdown in R-21 and perhaps the other wells. The louvered screen in PM-2 extends down about 1200 feet. The gamma log suggests that the upper 250-300 feet is where the bulk of the water is produced. The production rate of the well is about 1250 gallons per minute.

A 30-day pump test was done in water supply well O-4, but the screen in the observation well was above the screen in the pumping well, so no drawdown was observed. PM-2 and R-20 present a much better match. The second screen in R-20 is located right in the assumed highest production zone in PM-2 and the third R-20 screen is at the base of the assumed PM-2 productive zone. There is a pronounced vertical gradient, so we are pretty sure this is in a canyon recharge system.

PM-2 and the other PM production wells have been turned off since early December. We are working right now on getting equipment in to measure the static water level in the surrounding wells for about 10 days prior to the test. We expect to be able to stress the aquifer and we anticipate seeing drawdown in R-20 on the order of 10 feet, depending on the storativity. This magnitude of drawdown is distinct from barometric or tidal fluctuations. We may see drawdown at R-32.

Hydrology Question and Answer:
Question: Why is screen 1 in R-16 screened off?
Answer: Could not get the casing in. It is a dry zone that we initially thought might have water, but it did not.

Question: Was there a response in the low-head weir wells when R-9i was tested?
Answer: The testing at R-9i was done before the low-head weir wells were installed.

Question: How long has PM-2 been turned off?
Answer: The wells have been turned off since early December.

Question: Has anyone looked at the R-12 response to pumping in PM-1?
Answer: We have not looked because R-12 is not equipped with a transducer. Also, the relative placement of screens is important in determining the response.

Question: What is the volume of water that you expect to pump?
Answer: We have not calculated the volume of water, but Los Alamos County has been very supportive and helpful of this test and they are making adjustments in the distribution system to be able to push the water to be used elsewhere in the system. It is too much water for White

Rock to use. All of the water will be used in the supply system. The Lab will pick up the peak electrical surcharge to minimize the impact of the testing in Los Alamos County.

Question: R-21 is closer to PM-2 than R-32; are you planning to instrument R-21 as well?
Answer: Had not thought about that, but it is a good idea. We will also instrument R-21. We believe that there is about a 50/50% chance of seeing drawdown in R-32, probably a better chance in R-21.

Question: During the pump test, will the water be sampled and analyzed to determine the quality? PM-2 is an important well in terms of contaminants moving and additional data during the pump test may provide interesting data.
Answer: The Water Quality and Hydrology Group does monthly sampling of the water supply wells. We will try to coordinate the routine sampling with the testing. We will sample at least once, probably at the end of the test. If money is available, will sample more frequently.

Question: Won't the PM-2 capture zone change during the pump test such that different contaminants may be drawn in?
Answer: The well will not be pumped harder or differently than it is pumped when it is in use, so the capture zone is unlikely to be significantly different. For the PM-2 test, there will be three pumps going and the peak electrical surcharge will be $20,000 for one day. The County usually pumps at night to avoid the peak surcharge, so the Lab will be paying the surcharge.

Question: Sometime this year Los Alamos County will begin building a new wastewater treatment plant and to decommission the old plant. The traffic could be a problem with the well drilling. How can we coordinate?
Answer: We do want to coordinate. When we get funding and have a better idea of the schedule we will sit down with the County and work out a plan. We learned some lessons about drilling near heavy traffic in Pajarito Canyon and would like to avoid problems as much as possible.

FY03 Planning Discussion: Proposed DQOs for FY03 Wells
Charlie Nylander said that at the last Quarterly Meeting in October he had announced that it would be a difficult budget year. The continuing resolution is still in effect, although Domenici's office has indicated that the situation may be resolved in February. Until that time, expenses are constrained to the FY02 budget, and there would not be sufficient funds to drill FY03 wells. However, the plan is to install six wells in FY03. If accelerated funding comes through, perhaps it would be possible to install more wells. Right now, if there is no new money, there will be no new wells in FY03. If the funding comes in, it will be at mid-year and that means all the wells will be installed at the end of year, similar to FY02. Proposed Data Quality Objectives (DQOs) have been developed for the six FY03 wells. Due to the legal constraints associated with the Corrective Action Order, these DQOs were not developed with the concurrence of NMED as was planned. We hope that this forum will allow feedback to occur on the proposed DQOs such that NMED concurrence can be obtained before the wells are drilled and installed.

Pueblo Canyon: R-2

- Proposed Location: about one quarter mile down-gradient of Acid Canyon
- Subsurface distribution of contaminants in an area expected to contain the maximum groundwater contamination from Acid Canyon
- Groundwater pathways and interconnections between the surface and deep groundwater
- Identify geologic and hydrologic controls on groundwater pathways
- Water-level, aquifer characteristics, and chemistry data
- Drilling and completion:
    - Open borehole, using air with minimal fluids

- Core the upper portion of the boring
- Single screen just below the regional aquifer water table
- Total depth of about 100 ft below the regional aquifer table

- Pueblo Canyon: R-4Proposed Location: Pueblo Canyon as shown in HWP
- Subsurface distribution of contaminants in an area down gradient of releases in Pueblo Canyon and upgradient of the treatment plant effluent
- Groundwater pathways and interconnections between the surface and deep groundwater recharge in Pueblo Canyon
- Identify geologic and hydrologic controls on groundwater pathways
- Water-level, aquifer characteristics, and chemistry data for improving the regional flow and transport model
- Drilling and well completion:
  - Open borehole, using air with minimal fluids
  - Core the upper portion of the boring
  - Completion to be determined after analysis of R-5 data and particle-tracking simulation to determine how deep contaminants from Pueblo Canyon might be expected

Los Alamos Canyon: R-6

- Proposed Location: Los Alamos Canyon west of Los Alamos Canyon bridge
- Water quality in an area up gradient of all releases in from Laboratory operations
- Identify geologic and hydrologic controls on groundwater pathways
- Water-level, aquifer characteristics, and chemistry data in the recharge area for improving the regional flow and transport model
- Drilling and well completion:
  - Drilling method TBD by driller
  - Two screened intervals in the regional aquifer, approximately matching the two upper regional aquifer screens in R-25
  - Total depth penetrate about 300 feet into the regional aquifer

Sandia Canyon: R-11

- Proposed Location: below the break in slope in Sandia Canyon, where surface water flow is lost
- Perched zones are anticipated to occur as a result of infiltration of surface water; opportunity to assess pathways
- Highly fractured rock below break in slope may facilitate infiltration
- Examine the character of transition between Cerros del Rio basalts (R-9, R-12, R-13, R-15) and dacitic lavas (R-14)
- Drilling and well completion:
  - Open borehole using air with minimal fluids
  - Core the upper portion of the borehole, to auger refusal or 250 ft maximum
  - One screened interval in the regional aquifer

Potrillo Canyon: R-18

- Propose relocation to Potrillo Canyon, where R-32 was originally planned
- R-18 was proposed to provide information on presence, occurrence, and quality of perched zones and depth to regional aquifer in poorly understood part of the LabDue to access, R-18 cannot be drilled where it was shown in the Hydrogeologic Workplan; alternate locations do not have significant characterization value

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Cañon de Valle: R-26

- Proposed Location: between Ancho Ranch Road and West Jemez Road, water quality in an area up gradient of all releases from Laboratory operations
- Effect of the Pajarito fault on groundwater flow
- Presence or absence of a perching horizon similar to what is present at R-25
- Water-level, aquifer characteristics, and chemistry data in the recharge area for improving the regional flow and transport model
- Well drilling and completion:
  - Air with minimal fluids
  - Core the upper 200-foot portion of the borehole
  - Two screened intervals: one in the perched zone (if present) and one in the regional aquifer. If there are strong vertical gradients in the regional aquifer we will put two screens in the regional aquifer.
  - Total depth will be about 1500 ft and will penetrate about 100 feet into the regional aquifer.

In the next couple of weeks, DQOs will be developed for the rest of the wells, in order to be prepared for additional funding if it becomes available.

FY03 Non-Field Activities
The non-field activities also have been constrained under the continuing resolution budget, so the funding is less than necessary to accomplish what we would like. With additional funding, full funding will be restored to the non-field activities. The draft Groundwater Annual Status Report will be mailed out for review and comment at the end of this month.

FY03 Planned Work Question and Answer:
Question: Will you be able to drill during the rainy season in Pueblo Canyon?
Answer: Yes, we have to work with Emergency Management Operations and maintain radio contact.

Question: Last year there were borings done in Sandia Canyon around R-11. Do you have that data?
Answer: We have got core samples from those borings, which were to < 200 feet in Bandelier Tuff. We have had the core analyzed for moisture and anion profiles. There has been good communication with other projects around the Lab that have required drilling; they seek out our expertise and share data.

Groundwater Pathways Assessment
Charlie Nylander (LANL) introduced the presentation by saying that over the course of implementing the Hydrogeologic Workplan; various methods of prioritizing the work have been tried. The original Hydrogeologic Workplan had a set of criteria that were used to prioritize the wells. The work has been reprioritized many times, for example moving up wells to finish the Los Alamos/Pueblo Canyon area; moving up wells in response to HE in R-25; and drilling all the wells around TA-54 last year. The Groundwater Pathways Assessment is another tool for prioritizing work. It does not eliminate or replace work, but is a valuable tool for prioritizing the sequence of work.

Diana Hollis (LANL) made the Groundwater Pathways Assessment presentation. It is intended to be a first-order groundwater pathway assessment. The pieces of the assessment are:

- Infiltration model (Ed Kwicklis, Marc Witkowski)
- Geologic Data Model (Greg Cole, Bill Carey)
- Vadose Zone Model (Kay Birdsell, Bruce Robinson)

- Saturated Zone/Regional Aquifer Model (Elizabeth Keating, Velimir Vesselinov)
- Groundwater Contaminant Sources (Leslie Dale, Pat Longmire, David Rogers, Chris Echohawk, Marc Witkowski, Tom Riggs, Brent Newman)

The process, shown on a diagram, is summarized here.
The infiltration map, Geologic Data Model, and Contaminant Sources all feed into the Vadose Zone Model. The infiltration map provides the flux of water into the vadose zone. The Geologic Data Model provides the geologic framework. The contaminant sources provide the nature and extent of contamination. With those inputs, the vadose zone model is used to predict the flux of water through the bottom of the vadose zone (to the top of the regional aquifer) and the flux of dissolved contaminants through the bottom of the vadose zone (to the top of the regional aquifer). The Regional Aquifer Model is used to predict the flux of water through the regional aquifer (groundwater flow) and the flux of dissolved contaminants at supply wells (contaminant transport).

Parameters: Infiltration Map
Incorporates many parameters using GIS tools to quantify infiltration across the Pajarito Plateau:

- Precipitation
- Elevation
- Topography
- Geology
- Ecotone
- Subsurface moisture data
- Steam gauge data
- Runoff measurements
- Natural tracer data
- Anthropogenic sources

GIT peer review identified additional data sources, which will be added before final publication.

Parameters: Vadose Zone Model
Within the vadose zone model the following parameters are required:

- Infiltration – key controlling parameter
- Saturated hydraulic conductivity
- Unsaturated hydrologic properties
- Porosity
- Bulk density
- Moisture content
- Fracture prevalence
- Pore size distribution

Groundwater flux is calibrated using measured moisture in the vadose zone. Three scenarios are modeled:

- "base case" is the calibrated flow model
- "fast path" is three times the base-case infiltration, represents unsaturated flow directly through only Bandelier Tuff into saturated Puye
- "slow path" is one-third the base-case infiltration, represents unsaturated flow through all strata, including some unsaturated Puye

Parameters: Saturated Zone Model
Within the Saturated Zone Model the following parameters are required:

- Saturated hydraulic conductivity
- Effective porosity
- Bulk density
- Pore size distribution

The Saturated Zone Model is calibrated to measured hydraulic pressure. Three scenarios are modeled:

- "base case" is the calibrated flow model
- "fast path" uses effective porosity of 0.0001, represents preferential flow path
- "slow path" uses effective porosity of 0.2, represents porous flow

Groundwater Pathways Assessment Products:

- Travel times from the surface to the bottom of the vadose zone—These travel times increase from east to west, corresponding to the decreasing thickness of the vadose zone, with faster travel times in wet canyons.
- Travel times from the bottom of the vadose zone to the nearest supply well—These travel times are shortest near the supply wells (0-100 yrs) and longest in the western part of the Laboratory (> 1000 years). The Pajarito Mesa (PM) well field has the largest capture zone on LANL.
- Flow paths in the regional aquifer towards supply wells
- High-priority locations based on travel times to nearest pumping wells less than 100 years:
    - Mortandad Canyon
    - Water Canyon/ Cañon de Valle
    - Los Alamos/Pueblo Canyon
    - Sandia Canyon
    - Pajarito Canyon
- Map of contaminants detected in 2002 in alluvial, intermediate and regional groundwater in high-priority canyons
- Peer review to be conducted by GIT prior to official release

Path Forward

- Identify high-priority contaminants in high-priority canyons as those with transport times to supply wells less than 100 years considering: solubility, speciation, sorption, biodegradation, radioactive decay, dectections in groundwater
- Calculate flux of high-priority contaminants from source location to capture zones of supply wells for a period of 100 years
- Conduct phased risk assessments according to EPA's *Risk Assessment Guidance for Superfund*
- Calculations are underway for Mortandad Canyon:
    - Infiltration rates based on map and several site-specific water balance studies (including initial site characterization survey from 1960s)
    - Contaminant inventory estimates based on:
        - Historical annual discharge records for nitrate, tritium, strontium, cesium, americium, plutonium, and uranium
        - Scaling factor for perchlorate based on statistical correlations between nitrate and perchlorate measured in core samples
    - Transport of high-priority contaminants will be modeled between 1963 (when TA-50 began operations) and 2103 (100 years into the future) with source controls accounted for. Source controls include: nitrate discharge reduction by reverse osmosis system (2000); perchlorate discharge elimination by anion exchange system (2002); and alluvial groundwater contaminant sorption by permeable reactive barrier (2003)
    - Vadose zone transport calculations will be calibrated to core sample data
    - Fluxes of high-priority contaminants in capture zone of PM wells will be calculated

Groundwater Pathways Assessment Question and Answer:
Question: What is the 3 times "fast path" case in the vadose zone model based on?

Answer: Bruce Robinson's work suggests that three times is the most that would be expected.

Question: That work is in Los Alamos/Pueblo Canyon, what about other canyons?
Answer: We believe that conditions in Los Alamos/Pueblo Canyon adequately represent the conditions in other canyons

Question: Does the R-well data support the travel time to the base of the vadose zone?
Answer: Based on the occurrence of tritium, the travel times are consistent.

Question: The TA-50 treatment processes have remained the same over many years; is that what allows the development of scaling factors for perchlorate?
Answer: Yes, based on the perchlorate and nitrate correlation in pore water of the core.

Question: How were the scaling factors developed?
Answer: Linear regression of data in four boreholes. The data set does not include MCOBT-8.5 because there was no correlation. The four boreholes used result in a nice family of curves with R=0.6 to 0.9. We used the 95% upper confidence limit of the data. We know the annual value of nitrate in the outfall, and we used the correlation equation from MCOBT-4.4 to calculate the expected perchlorate concentration. We used MCOBT-4.4 because it was closest to the source, had the most data, and the regression gave the highest mass of perchlorate.

Question: There is data on the amount of perchlorate in the outfall, was this used?
Answer: We did look at those numbers and they compare well, but there is not enough of that data for the statistical analysis. Also, since most of the data are after the treatment changes, it is not comparable.

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Information Management Subcommittee Status Report

Hydrogeologic Characterization Program Quarterly Meeting

January 22, 2003

NNSA

Los Alamos

Quarter in Review

1. ERDB/WQDB Chemistry Data Exchange
2. Exchange of Data with non-LANL Organizations
3. Integrated Groundwater Data Management
4. Software Development

WQH/ER Chemistry Data Exchange

Status

- Data was exchanged in December and January
- A regular schedule established
- Issues are regularly discussed at joint meetings

Exchange of Data with Non-LANL Organizations

Status of Exchange with NMED-OB

- Requirements for exchanging data identified
- Program languages considered and a final choice made
- Comparison of lookup values in progress
- Programming will commence in next quarter

Integrated Groundwater Data Management

Well Construction Data

- Transitioning to enter directly into WQDB
- Procedures for Quality Review established
- Personnel for review and data entry identified and in training

Water Level Data Collection

Status:

- Define a standard files format
- Programming to start in coming quarter

Software Development

Validation and Verification Web Interface

- Currently being developed

Looking Ahead

Final Phase I development

- Spike Level Tracking
- Upgrade to EDD Parser
- Invoice Tracking

Quarterly GIT Meeting

Well Construction Subcommittee Report

January 22, 2003

John McCann

Overview

- Accomplishments This Quarter
- Well Development Challenges
- Current Activities
- Sampling Activities
- Reporting Activities

Accomplishments Last Quarter

- R-14
  - Completed final development and collection of baseline groundwater samples from each screened interval
  - Removed a total of 205,010 gallons of groundwater during development
  - Completed hydrological testing
  - Installed Westbay sampling system with two ports

Accomplishments Last Quarter

- R-16
  - Completed final development and collection of baseline groundwater samples from each screened interval
  - Removed a total of 100,120 gallons of groundwater during development
  - Completed hydrological testing
  - Installed Westbay sampling system with three ports

Accomplishments Last Quarter

- R-20
  - Obtain core from offset boring from 75 to 416 ft
  - Completed final development and collection of baseline groundwater samples from each screened interval
  - Removed a total of 113,070 gallons of groundwater during development
  - Completed hydrological testing

Accomplishments Last Quarter

- R-23
  - Completed successful backfill operations on well; single screen completion
  - Performed well development, removing a total of 25,900 gallons of groundwater to date

Accomplishments Last Quarter

- R-32
  - Completed final development and collection of baseline groundwater samples from each screened interval
  - Removed a total of 144,670 gallons of groundwater during development
  - Completed hydrological testing
  - Installed Westbay sampling system with three ports

Well Development Challenges

- Faced several challenges in the well development area:
  - Removal of drilling fluids from the wells
  - Increasing the yield of the wells
  - Logistics related to developing five wells at the same time
- These problems required the use of chemical additives to support development

Current Activities

- Waste management at these wells is continuing
- Site restoration activities scheduled to begin early February

Status of Sampling Activity

- Sampling was conducted this quarter at wells
  - CdV-R-37-2
  - R-13

Status of Reporting Activity

- Accomplishments in the reporting area include
  - Preparation of Fact Sheets for R-14, R-16, R-20, R-23 and R-32
  - Preparation of two Geochemistry Reports for R-7 and R-22
  - Preparation of one Well Completion Report for MCOBT-4.4/8.5

STATUS REPORT FOR GEOCHEMISTRY SUBCOMMITTEE, GROUNDWATER INTEGRATION TEAM

BY

PATRICK LONGMIRE, BRENT NEWMAN, DALE COUNCE, AND DAVID ROGERS

JANUARY 22, 2003

OBJECTIVE OF PRESENTATION

Present a summary of geochemical investigations conducted at Los Alamos National Laboratory from April 2002 through January 2003.

Topics of interest include:

- Quarterly Groundwater (Characterization) Sampling
- Pajarito Canyon Core Analysis
- TA-16 Hydrological and Geochemical Investigations
- Geochemistry Characterization Reports

R-WELL SCREENS, MEASUREMENT PORT DEPTHS, AND SAMPLING ROUNDS

R-5	Four Screens: 169 ft, 375 ft, 678 ft, and 860 ft; 1 Round
R-7	Three Screens: 378 ft, 744 ft (dry), and 915 ft; 4 Rounds
R-8A	Two Screens: 731 ft, 825 ft; *0 Rounds*
R-9	*Single Screen*: 741 ft; 4 Rounds
R-9i	Two Screens: 199 ft and 279 ft; 4 Rounds
R-12	Three Screens: 468 ft, 507 ft, and 811 ft; 4 Rounds
R-13	*Single Screen*: 940 ft; 2 Rounds
R-15	*Single Screen*: 1019 ft; 4 Rounds
R-19	Seven Screens: 844 ft (dry), 909 ft, 1190 ft, 1413 ft, 1586 ft, 1730 ft, and 1835 ft; 4 Rounds
R-22	Five Screens: 907 ft, 962 ft, 1273 ft, 1378 ft, and 1448 ft; 4 Rounds
R-25	Eight Screens: 755 ft, 892 ft, 1063 ft, 1192 ft, 1303 ft, 1406 ft, 1605, and 1796 ft; 4 Rounds
R-31	Five Screens: 454 ft, 532 ft, 670 ft, 831 ft, 1011 ft; 2 Rounds
MCOBT-4.4	*Single Screen*: 524 ft; 3 Rounds (1 pre-characterization, 2 characterization rounds)
CDV-15	Six Screens: 624 ft (dry), 806 ft (dry), 968 ft (dry), 1254 ft, 1350 ft, 1640 ft; 8 Rounds
CDV-37	Four Screens: 927 ft, 1201 ft, 1365 ft, 1553 ft; 4 Rounds

Post characterization sampling was conducted during July and August 2002 at several wells (R-22 [highest priority], R-25, R-15, R-9, R-9i, R-12, R-7, and R-19 [lowest priority]). R-9 and R-15 shall be sampled at a later date.

GROUNDWATER PROTECTION PROGRAM

CHARACTERIZATION WELLS R-16, R-20, R-21, R-23, and R-32

Groundwater screening samples were collected from R-14, R-16, R-23, and R-32 prior to well construction for limited suite analyses. Additional samples shall be collected for full suite analyses prior to hydraulic testing at the wells. Core samples were collected from R-14, R-21, R-23, and R-32 and analyzed for anions, radionuclides, volatile organic compounds, and stable isotopes.

TA-16 HYDROLOGICAL AND GEOCHEMICAL INVESTIGATIONS

The Geochemistry Team completed a series of three borehole analyses (160 ft) for barium and several anions. The objectives included evaluation of vertical and lateral variability in site hydrology and possible contaminant distributions. Distributions of chloride suggest low downward fluxes and similar hydrologic behavior between the east and west lobes of Material disposal Area (MDA)-P. Shallow barium contamination was observed in one borehole at a depth less than two ft. Alluvial groundwater near the 260 outfall is characterized by reducing conditions that should enhance degradation of contaminants. Reducing conditions are characterized by decreasing concentrations of TNT, nitrate, and sulfate and increasing concentrations of iron.

SUMMARY OF CONSTITUENTS OF INTEREST IDENTIFIED AT MCOBT-4.4 (Two Characterization Rounds with Validated Data)

Depth (ft)	Date	Chemical	Concentration
524	04/22/02	Tritium	12,797±1,368 (3σ) pCi/L
		Nitrate (N)	13.2 mg/L
		Perchlorate	142 µg/L
524	06/28/02	Tritium	14,600±759 (3σ) pCi/L
		Tritium	14,900±768 (3σ) pCi/L
		Nitrate (N)	12.5 mg/L
		Nitrate (N)	12.5 mg/L
		Perchlorate	178 µg/L
		Perchlorate	179 µg/L

GEOCHEMISTRY CHARACTERIZATION REPORTS

- Geochemistry Characterization Reports for R-9 and R-9i, R-12, R-15, R-19, and R-22 have been provided to DOE as formal deliverables. The R-7 geochemistry report is in press.
- Geochemistry Characterization Reports provide information on analytical results for inorganic and organic chemicals and radionuclides measured during four sampling events.
- Geochemical interpretation including calculations is provided in each report.

GROUNDWATER PROTECTION PROGRAM

SUMMARY

- Geochemistry Subcommittee members have collected characterization groundwater samples from alluvial ground water, R-13, CdV-15, CdV-37, and MCOBT-4.4 from April 2002 through January 2003.
- Borehole samples have been collected from MDA-P, R-14, R-16, R-21, R-23, and R-32.
- Geochemistry reports for R-9 and 9i, R-12, R-15, R-19, and R-22 have been delivered to DOE. A geochemistry report for R-7 is in press.
- Constituents of interest in well MCOBT-4.4 include nitrate, perchlorate, and tritium.
- Groundwater with measurable tritium occurs at R-5, R-7, R-8, R-9, R-9i, R-12, R-15, R-22, R-25, and MCOBT-4.4. These wells contain a component of groundwater less than 60 years old. Activities of tritium are less than detection at well R-19, indicating that the well has not experienced recent recharge.

SUPPLEMENTAL MATERIAL FOR GEOCHEMISTRY SUBCOMMITTEE

ANALYTICAL METHODS EPA SW846

- Metals- Inductively Coupled Plasma Optical Emission Spectroscopy and Inductively Coupled Plasma Mass Spectrometry
- Anions- Ion Chromatography
- Organic Compounds- Gas Chromatography and Gas Chromatography-Mass Spectrometry
- High Explosive Compounds- High Pressure Liquid Chromatography and Diode Array Detector
- Radionuclides- Alpha Spectrometry, Gas Proportional Counting, Gamma Spectroscopy, Direct Counting, and Electrolytic Enrichment
- Stable Isotopes- Isotope Ratio Mass Spectrometry

SAMPLING PROTOCALS AT R-WELLS

- Purge single completed wells, removing at least 3 well bore volumes; measure field parameters; collect; filter; and preserve (if required).
- Collect groundwater samples at multicompleted wells; measure field parameters; filter; and preserve (if required). Groundwater samples are collected using the Westbay Instruments at a rate of four liters per hour (one trip per hour).

GIT Modeling Subcommittee Report Quarterly Meeting

Bruce Robinson

January 22, 2003

Los Alamos

Slide 1

Groundwater Modeling Activities

- Groundwater Modeling Support for the Integrated Groundwater Protection Strategy
  - Infiltration study
  - Vadose zone transport
  - Transport in the regional aquifer
- Regional Aquifer Modeling

  Last quarter:
  - Incorporation of new geologic models
  - Initial Calibration results

  Current Work:
  - Ongoing model development
  - Communications

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Slide 2

Infiltration Study

- Participants: Ed Kwicklis, Marc Witkowski, Kay Birdsell, Doug Walther, Brent Newman
- Objective: Develop a Plateau-wide map of net infiltration for use in water resource and contaminant risk assessments
- Methodology
  - Compile previously developed estimates of net infiltration
  - Develop maps of environmental variables likely to impact infiltration (topography, vegetation, soils, geology)
  - Extrapolate infiltration estimates from regions with data to other areas based on mapped environmental variables
- Current status: Preliminary map has been developed, work is under internal review

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Slide 3

Infiltration Study: Draft Map

Los Alamos

Slide 4

Vadose Zone and Regional Aquifer Transport

Initial transport calculations are being prepared to predict transport of nitrate and perchlorate in Mortandad Canyon. Steps include:

- Source term estimates
- Infiltration estimates
- Vadose zone calculations of nitrate and perchlorate transport through 1D vadose zone pathways
- Comparisons to moisture and contaminant profiles are ongoing
- Simulations of regional aquifer transport taking the vadose zone contaminant fluxes as input

Work is in draft stage: therefore, quantitative results are not yet available

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Slide 5

Regional Aquifer Model: Ongoing Development

- Ongoing evaluation of impact of recent data (water levels, stratigraphy, etc.) on model results
- Capture zone analyses with uncertainties
- Evaluation and refinement of porosity estimates by comparing simulated and measured C-14 concentrations
- Supporting calculations for Integrated Groundwater Protection Strategy

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Slide 6

Regional Aquifer Model: Communications

- Two presentations at the American Geophysical Union annual meeting
- Summary sections in the FY02 Groundwater Annual Status Report
- Draft of high-level summary of regional aquifer model (in prep.)
- Meetings with stakeholders and other interested parties

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Slide 7

HYDROLOGY SUBCOMMITTEE REPORT

presentations at the

Quarterly Meeting of LANL's
Hydrogeologic Characterization Program

by William Stone

Pojoaque, NM
22 January 2003

UPDATE ON THE HYDROLOGIC TESTING REPORT

by W. Stone & S. McLin

BACKGROUND

Not a deliverable, but needed

Previous tests at LANL poorly documented

Even if a report is available, *not* always *enough* detail *to evaluate results*

PURPOSE

Results for *R-9i, R-13, R-19, R-22, R-31* (map)

But more required because is the first report

Document test *design, execution, analysis* (summary tables)

Present data (appendices)

Address *quality of results* (discussion, basic questions)

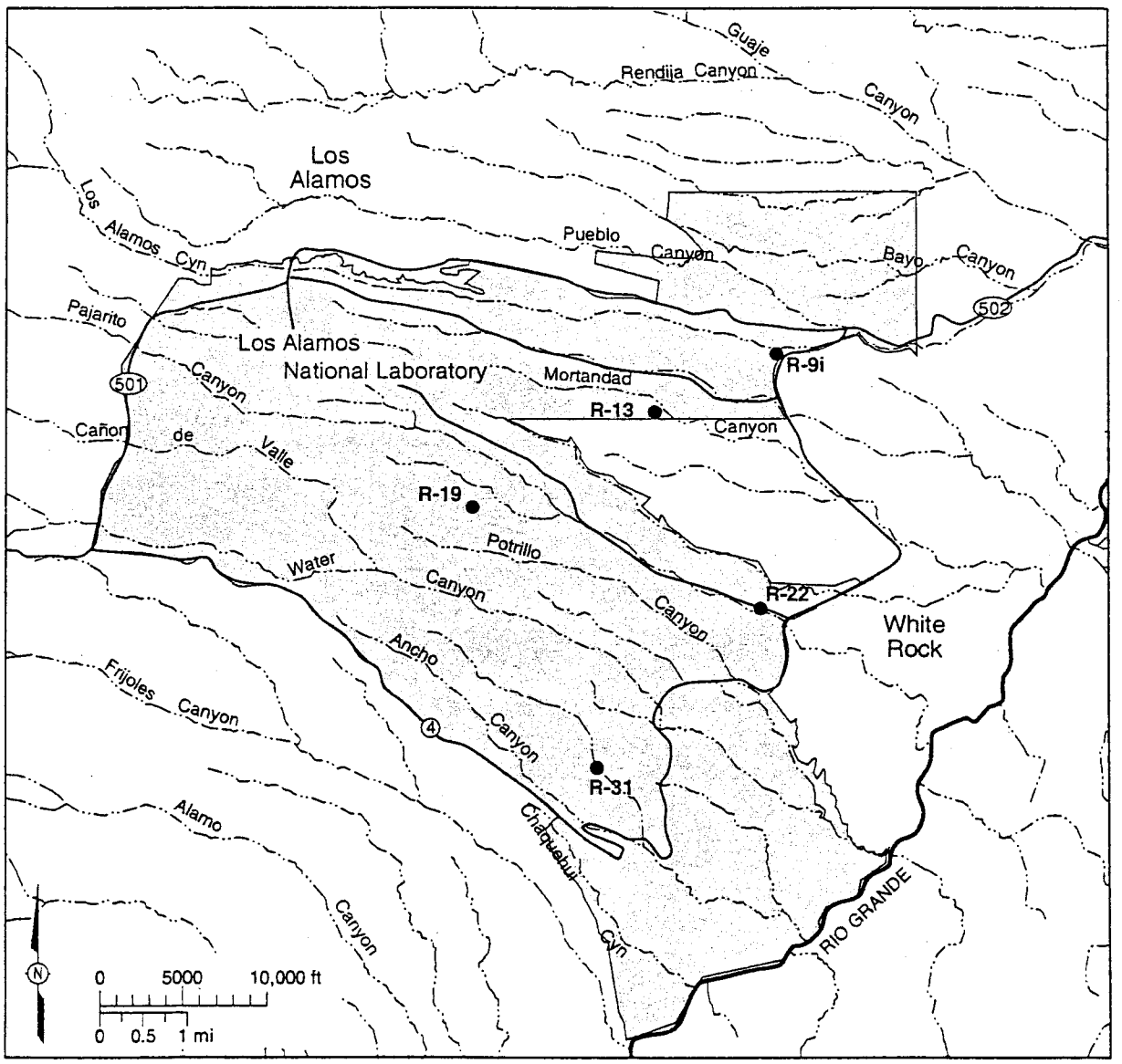
STATUS

In final review now!

OVERVIEW OF WELLS

Deep wells to the regional zone of saturation are being installed at the Laboratory as part of a program to improve the conceptual hydrogeologic model for the Pajarito Plateau (LANL 1998, 59599). Although some of these wells may become part of the groundwater surveillance network, they are characterization wells. That is, each provides geologic, hydrologic, and hydrochemical observations in an area where there are data gaps. The information obtained will be used to design a sound groundwater-monitoring network.

The drilling, construction, and development of the wells are briefly outlined below. Complete details can be found in the well-completion reports listed above. Methods used in drilling, constructing and developing the wells are compatible with Environmental Protection Agency (EPA) guidelines (Aller et al. 1991, 70112).



F1/HydroTest/082902/RLM

Figure 1. Location of wells tested

with the same injection rate and time was also run for comparison. Finally, screen 5 was tested. Test design and results for all tests are summarized in Table 11. Analyses of injection-test data are shown in Figures 17 through 20. Field and analytical data are given in Appendix D.

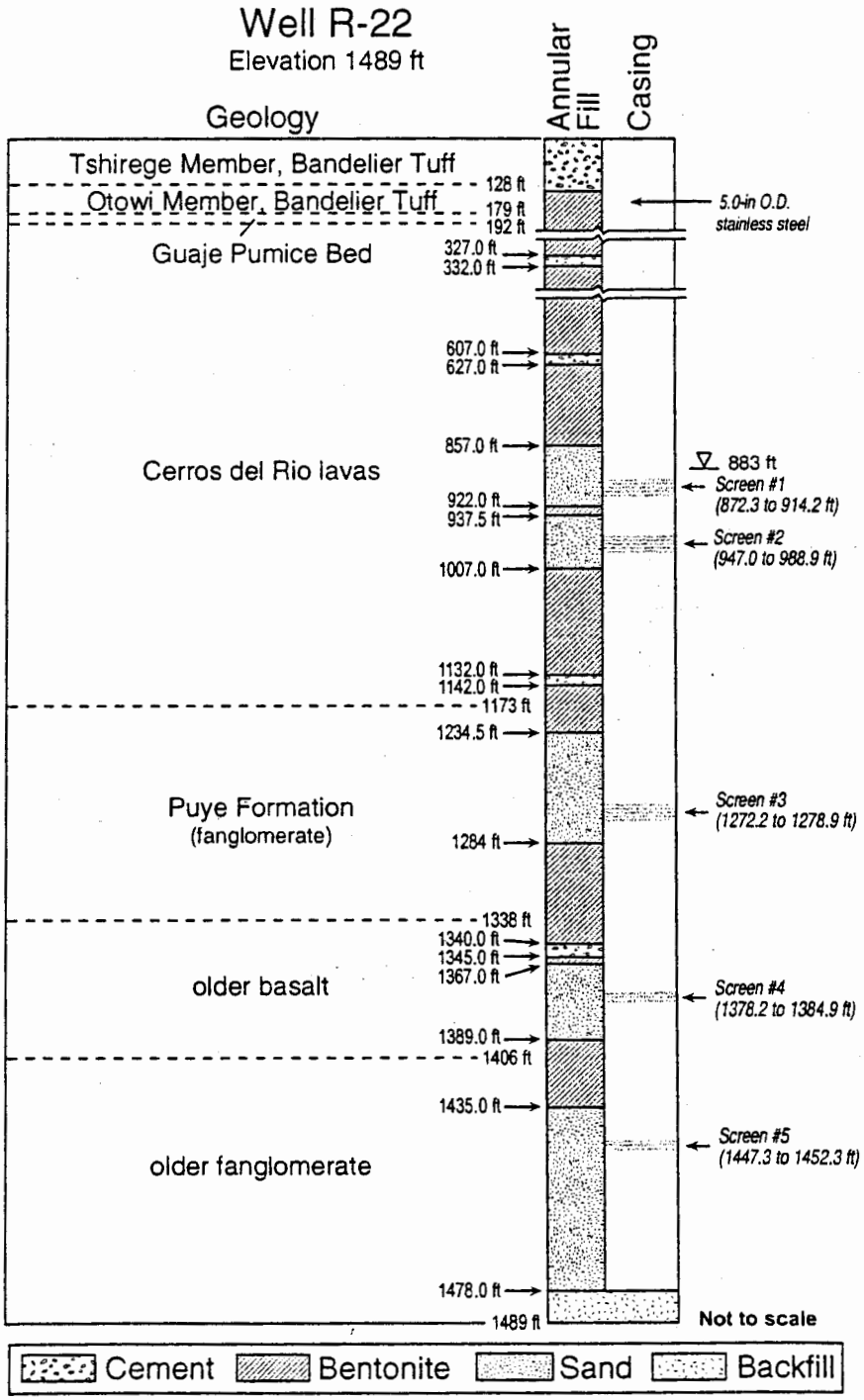


Figure 16. Hydrogeology and construction of R-22

Table 11
Summary of Injection Testing at R-22

Screen #	2	3	4[a]	5
Geologic Unit[b]	Tb	Tpt	Tbo	Tfo
Screened Interval (ft)[c]	947–988.9	1272.2–1278.9	1378.2–1384.9	1447.3–1452.3
Screen Length (ft)	41.9	6.7	6.7	5.0
Test Design				
Pre-Test Water Level (ft)[d]	899.6	948	955.5	955.5
Average Injection Rate (gpm)[e]	9.12	12.0	a) 16 b) 16	17
Injection-Rate Variation (%)	<10	<10	<10	<10
Injection Period (min)	19	10	a) 3 b) 3	3
Volume Injected (gal.)	150	140	a) 50 b) 50	50
Conducted by[f]	WS	WS	WS	WS
Date	11/15/00	11/16/00	11/17/00	11/17/00
Comments:	—	Drill rod slipped 4.8 in. during test and stripped transducer cable	Two tests run with identical parameters	—
Test Results				
Analyzed by[f]	SM	SM	SM	SM
Analytical Method	Bouwer-Rice C-B-P Hvorslev	Bouwer-Rice C-B-P Hvorslev	Bouwer-Rice C-B-P Hvorslev	Bouwer-Rice C-B-P Hvorslev
Hydraulic Conductivity (ft/d)[g]	0.03 0.05 0.03	0.16 0.49 0.11	a) 0.86 0.57 0.64 b) 0.91 0.63 0.64	0.60 0.55 0.40
Comments:	—	—	—	—

[a] Two tests were conducted for this screen to check reproducibility of results.
[b] Tb = Cerros del Rio basalt; Tpt = Puye Formation, Totavi Lentil; Tbo = older basalt; Tfo = older fanglomerate.
[c] For open interval, not screen joints.
[d] Depth bgs for packed-off interval, not well (composite static water-level depth for well = 890 ft).
[e] Determined by flowmeter and watch with second hand.
[f] WS = W. Stone, SM = S. McLin.
[g] Results are for Bouwer-Rice, C-B-P, and Hvorslev, respectively.

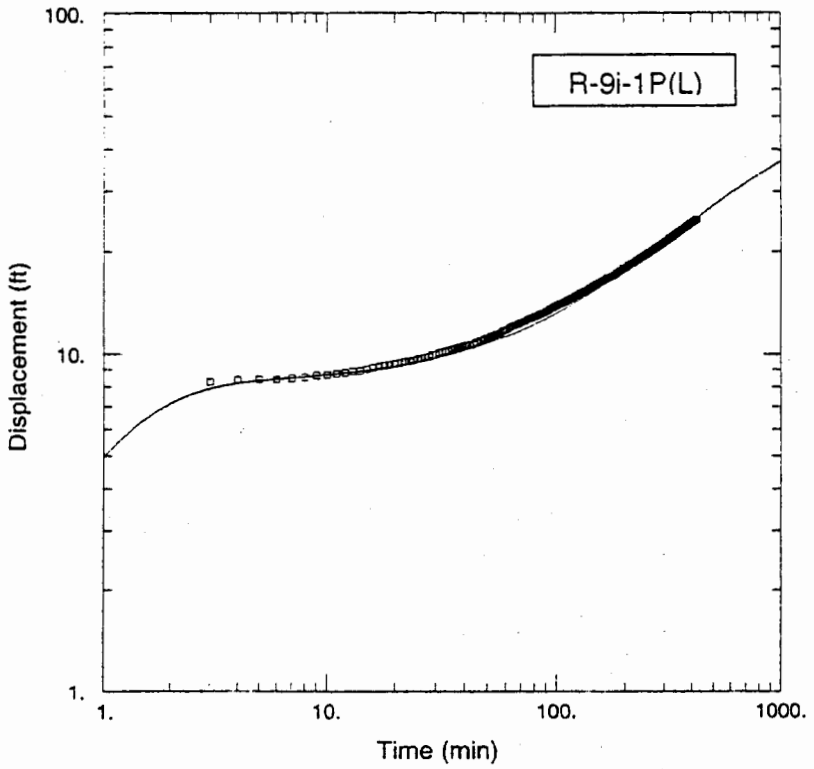


Figure 10. Neuman analysis of late pumping test drawdown data for R-9i, both screens

Discussion

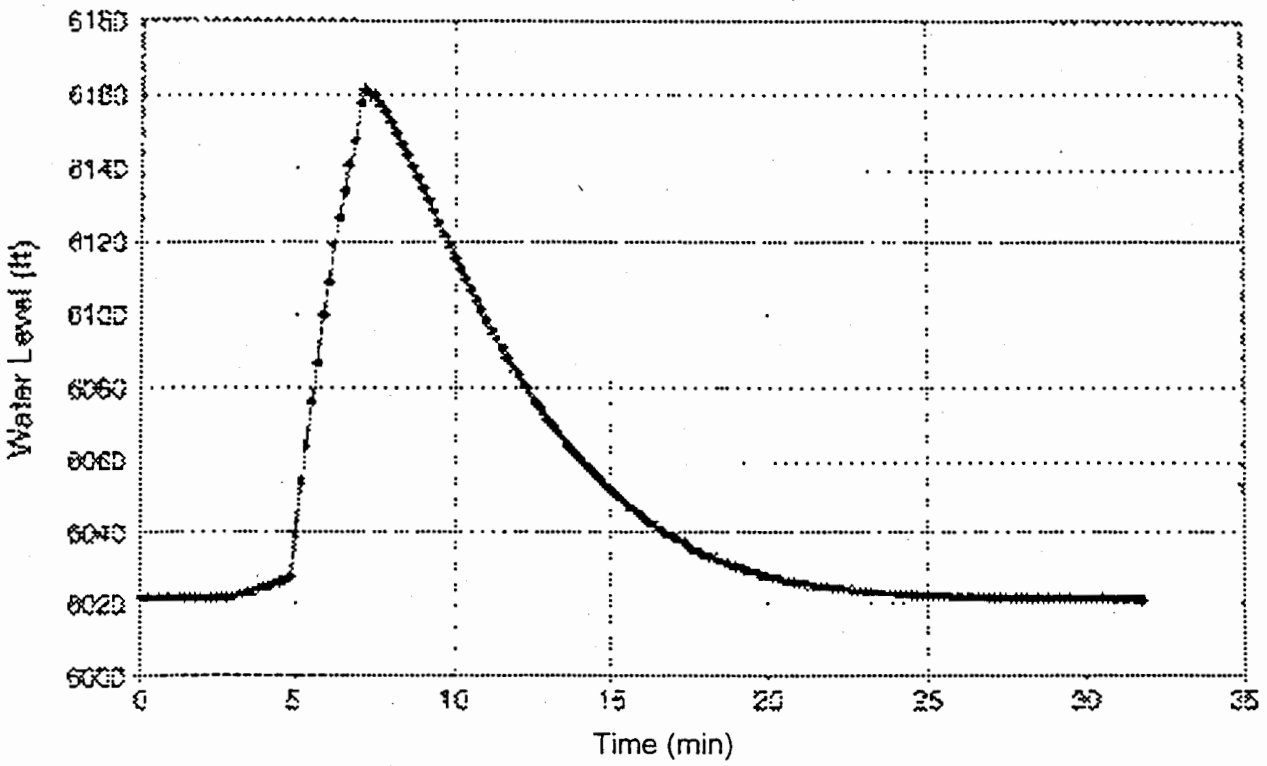
Injection Tests. Two tests were conducted for screen 1. During the first test (R-9-i-1a), water level dropped sharply in the midst of recovery (the double-peak curve at the left in Appendix A-1). This drop may have be in response to the fractured nature of the basalt behind the screen. A repeat test (R-9i-1b) conducted with a greater injection rate and time did not give this response.

Water injected at screen 2 quickly rose to the surface. Although Figure 5 shows a static water level for the lower perched zone of 264 ft bgs, a water-level depth of only 141 ft was measured with the packers set on that zone prior to testing. The reason for this discrepancy is that the hole had been open to both zones before the packers were set at the lower screen and the water level did not drop to a position appropriate for the lower zone because of its low permeability. Thus, water remained at the composite level and a rise of only 142 feet was sufficient to cause water to overflow the rod connected to the injection assembly.

Pumping Test. Inasmuch as the lower screened interval was tight, it was reasoned that pumping the well when it was open to both screens would in fact test mainly the upper productive interval. Results are not the same as if only screen 1 were tested by pumping. However, as screen 2 was nonproductive, the test probably gives order-of-magnitude results for the basalt in screen 1.

Analysis. The water-level response to injection at screen 1 (Appendix A-1) is similar to that in traditional slug tests. Therefore, we analyzed injection-test data for well R-9i, screen 1 by the Bouwer-Rice slug technique. The Bouwer-Rice plot for the initial injection test (R-9i-1a) is shown in Figure 6. The linear portion of the plot (i.e., the first 150 seconds) covers most of the data points collected and is the valid part of such plots. The upward turn of the plot after that is a typical Bouwer-Rice response. Bouwer-Rice

D-8. Plot for Injection Test, R-22, Screen 4a



D-9. Recovery Data for Injection Test, R-22, Screen 4a

t (min)	s (ft)	t (min)	s (ft)	t (min)	s (ft)	t (min)	s (ft)
0.000	139.655	3.000	91.320	6.000	47.388	9.000	21.985
0.167	138.585	3.167	88.376	6.167	45.571	9.167	20.932
0.333	138.296	3.333	85.518	6.333	43.826	9.333	19.938
0.500	136.057	3.500	82.747	6.500	42.125	9.500	18.943
0.667	133.861	3.667	79.947	6.667	40.409	9.667	18.021
0.833	131.189	3.833	77.234	6.833	38.794	9.833	17.099
1.000	127.650	4.000	74.594	7.000	37.222	10.000	16.248
1.167	124.948	4.167	71.997	7.167	35.708	10.167	15.427
1.333	122.016	4.333	69.429	7.333	34.252	10.333	14.634
1.500	118.882	4.500	66.846	7.500	32.839	10.500	13.870
1.667	115.936	4.667	64.365	7.667	31.470	10.667	13.150
1.833	112.918	4.833	61.956	7.833	30.086	10.833	12.458
2.000	110.016	5.000	59.619	8.000	28.788	11.000	11.795
2.167	106.796	5.167	57.498	8.167	27.563	11.167	11.147
2.333	103.850	5.333	55.335	8.333	26.367	11.333	10.455
2.500	100.588	5.500	53.272	8.500	25.199	11.500	9.994
2.667	97.758	5.667	51.253	8.667	24.089	11.667	9.475
2.833	94.279	5.833	49.277	8.833	23.022	11.833	8.985

OVERVIEW OF TESTING THE 2002 WELLS

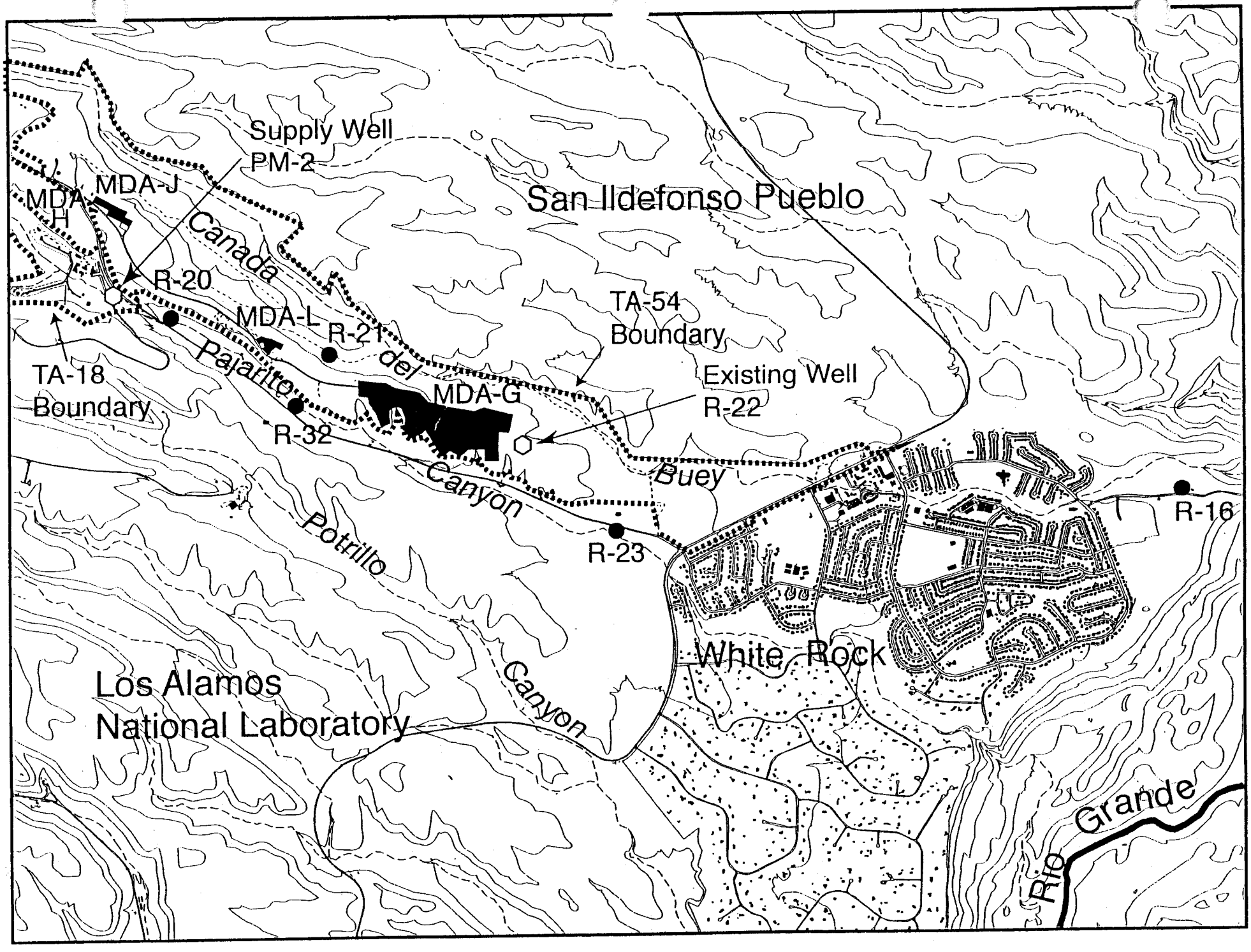
BACKGROUND

Most aspects *as before*

- Straddle-packer/injection tests
- Testing scheduled for winter!

But *some changes*

- Supported by *different contractor*
  - Learning curves
    - Equipment - what, where
    - Methods – packers, flow, injection
  - *Smaller rods*
    - Compatible with hose?
    - Impact delivery of water?
- New protocol - ideally *three tests/screen*
  1. Injection at low rate, short time (min)
  2. Injection at higher rate, same time
  3. Injection at same rate, long time (hrs)


Supply Well
PM-2
MDA-J
MDA-H
San Ildefonso Pueblo
Canada
R-20
MDA-L
R-21
del
TA-54
Boundary
Pajarito
TA-18
Boundary
MDA-G
Existing Well
R-22
R-32
Buey
Canyon
Potrillo
R-23
R-16
White Rock
Canyon
Los Alamos
National Laboratory
Rio Grande

SUMMARY

Well	*Screen*	*Unit*[1]	*Tests*[2]
R-14	1	Tpf	(same as #2)
	2	Tpf	2 injection
R-16	1	Tpf	(cased off)
	2	Tsf	3 injection
	3	Tsf	3 injection
R-20	1	cinder	2 injection
	2	Tpp	3 injection
	3	Tpt?	3 injection
R-23	1	Tsf	P test scheduled
R-32	1	gravel/Tb	3 injection
	2	Tpf	(pressure port)
	3	Tpf	3 injection

[1] Tpf = Puye Fm. fanglomerate, Tpp = pumiceous Puye Fm., Tpt = Totavi Lentil, Tsf = Santa Fe Grp.

[2] multiple injection tests involve 2 short tests (1 min) at different rates and 1 long test (1 hr) at higher of short test rates

Hydrology Subcommittee Reports

Status of the PM-2 Pump Test

by

Stephen G. McLin

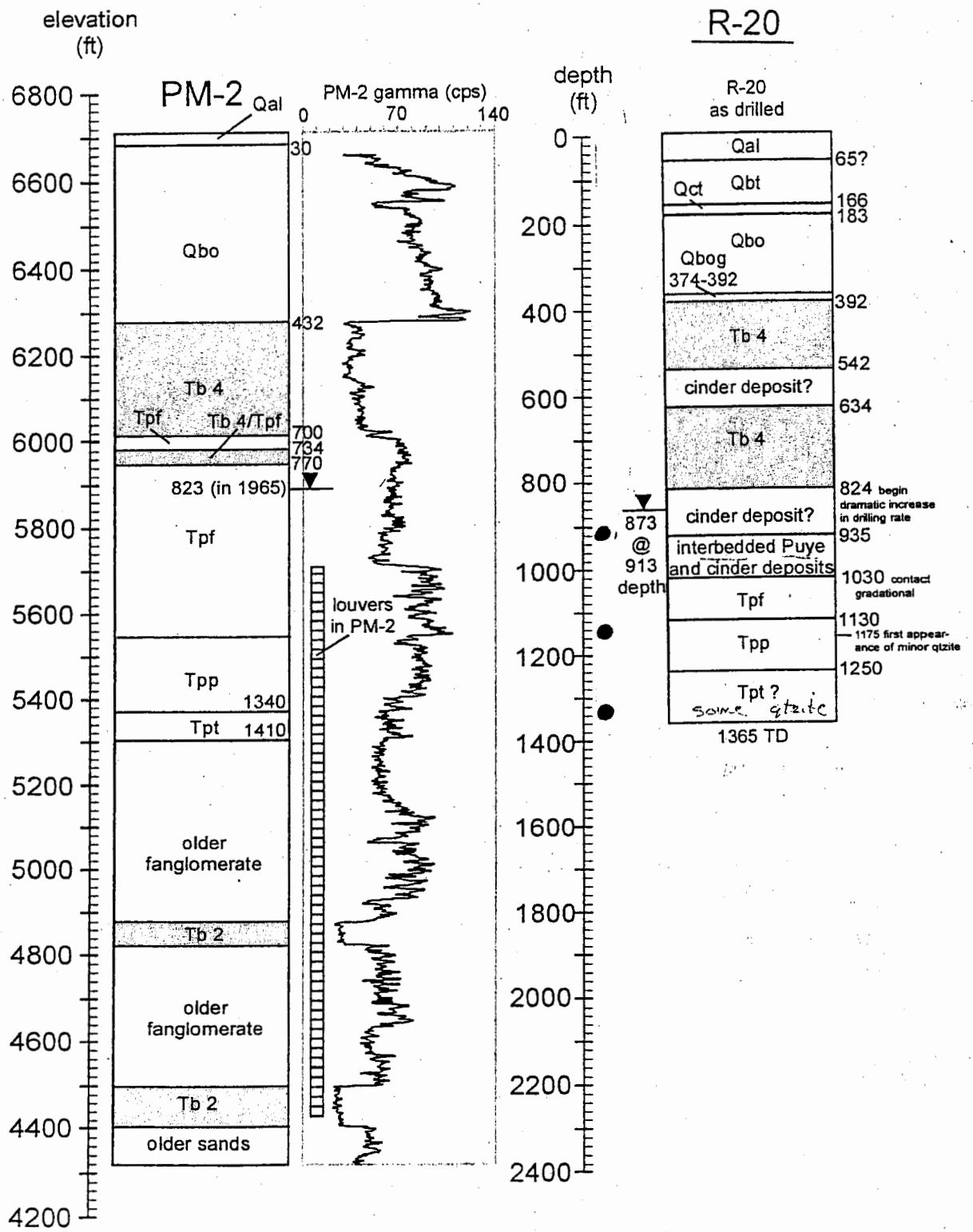
Water Quality and Hydrology Group (RRES-WQH)

presented at

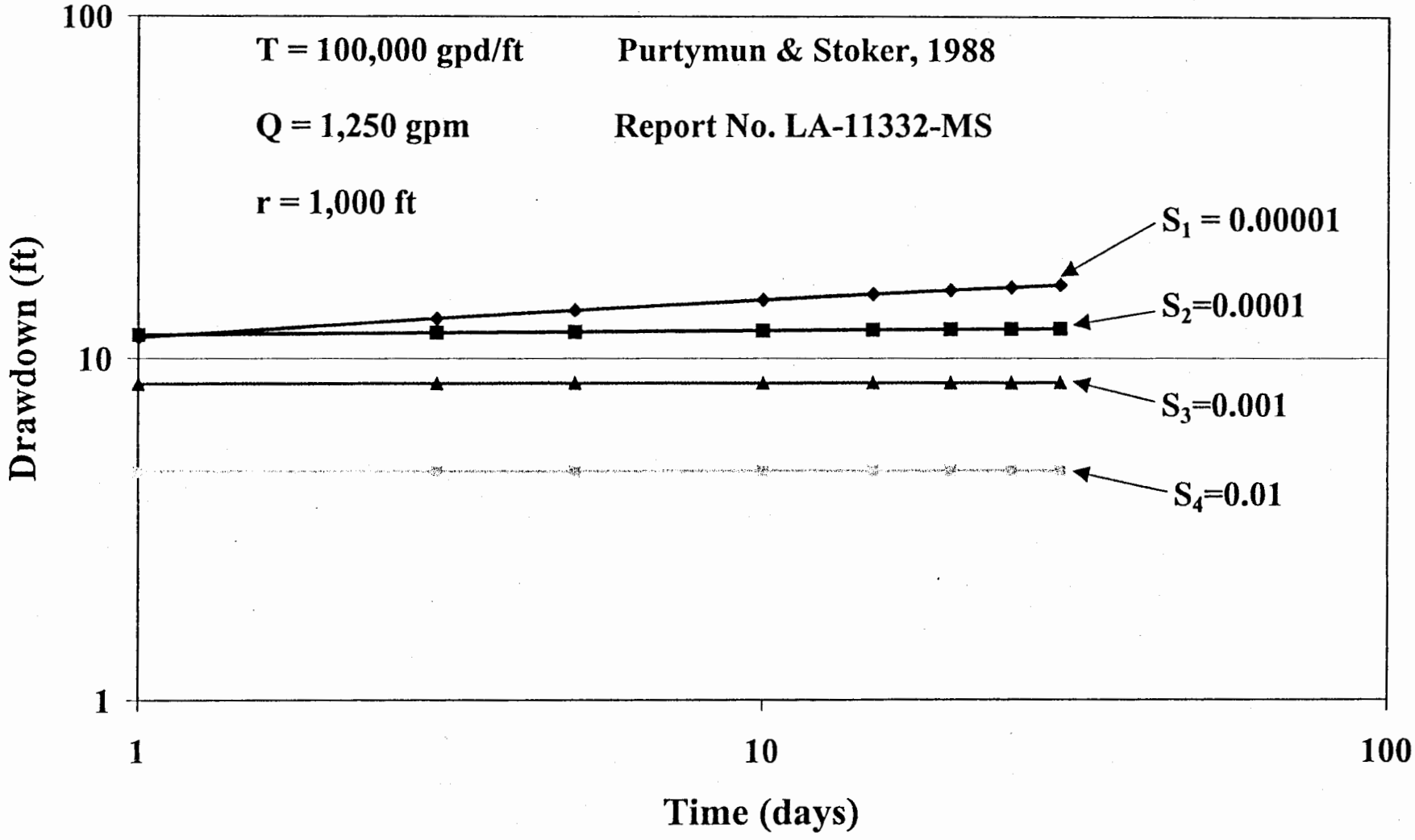
Quarterly Meeting of LANL's

Hydrogeologic Characterization Program

January 22, 2003


elevation (ft)
PM-2
Qal
PM-2 gamma (cps)
0
70
140
6800
6600
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
30
Qbo
432
Tb 4
Tpf
Tb 4/Tpf
700
734
770
823 (in 1965)
Tpf
louvers in PM-2
Tpp
1340
Tpt
1410
older fanglomerate
Tb 2
older fanglomerate
Tb 2
older sands
depth (ft)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
873 @ 913 depth
R-20
R-20 as drilled
Qal
65?
Qct
Qbt
166
183
Qbo
Qbog
374-392
392
Tb 4
542
cinder deposit?
634
Tb 4
824 begin dramatic increase in drilling rate
cinder deposit?
935
interbedded Puye and cinder deposits
1030 contact gradational
Tpf
1130
1175 first appearance of minor qtzite
Tpp
1250
Tpt ?
some qtzite
1365 TD

Anticipated Drawdown at Well R-20



UNCLASSIFIED

FY03 Proposed Work

Charlie Nylander
Groundwater Protection Program Manager

UNCLASSIFIED

Proposed FY03 Field Activities

- **With current budget: No new wells in FY03**
- If additional budget is available, install:
  - **NWT: R-2, R-6, R-11, & R-26**
  - **ER: R-4 & R-18**
- Characterization sampling and analysis
- Hydrologic testing

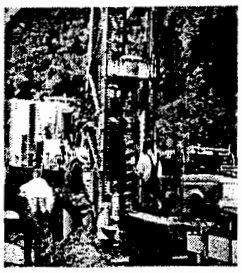
UNCLASSIFIED

Pueblo Canyon: Well R-2

- Subsurface distribution of contaminants in an area expected to contain the maximum groundwater contamination from Acid Canyon
- Groundwater pathways and interconnections between the surface and deep groundwater
- Identify geologic and hydrologic controls on groundwater pathways
- Water-level, aquifer characteristics, and chemistry data
- Proposed location: about one quarter mile down gradient of Acid Canyon

UNCLASSIFIED

R-2 Drilling and Well Completion



- Open borehole using air with minimal fluids
- Core the upper portion of the boring
- Single screen just below the regional aquifer water table
- Total depth of about 100 ft below the regional aquifer table

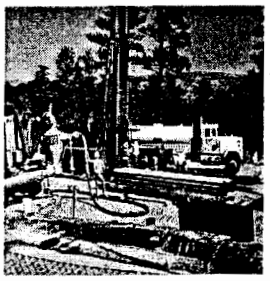
UNCLASSIFIED

Pueblo Canyon: Well R-4

- Subsurface distribution of contaminants in an area down-gradient of releases in Pueblo Canyon and upgradient of the treatment plant effluent
- Groundwater pathways and interconnections between the surface and deep groundwater recharge in Pueblo Canyon
- Identify geologic and hydrologic controls on groundwater pathways
- Water-level, aquifer characteristics, and chemistry data for improving the regional flow and transport model
- Proposed location: Pueblo Canyon as shown in HWP

UNCLASSIFIED

R-4 Drilling and Well Completion



- Open borehole using air with minimal fluids
- Core the upper portion of the boring
- Completion to be determined after analysis of R-5 data and particle-tracking simulation to determine how deep contaminants from Pueblo Canyon might be expected

UNCLASSIFIED

Los Alamos Canyon Well R-6

- Water quality in an area upgradient of all releases in from Laboratory operations
- Identify geologic and hydrologic controls on groundwater pathways
- Water-level, aquifer characteristics, and chemistry data in the recharge area for improving the regional flow and transport model
- Proposed location:Los Alamos Canyon west of Los Alamos Canyon bridge

UNCLASSIFIED

R-6 Drilling and Well Completion

- Drilling method TBD by driller
- Two screened intervals in the regional aquifer, approximately matching the two upper regional aquifer screens in R-25
- Total depth penetrate about 300 feet into the regional aquifer

UNCLASSIFIED

Sandia Canyon: Well R-11

- Proposed location: below the break in slope in Sandia Canyon, where surface water flow is lost.
- Perched zones are anticipated to occur as a result of infiltration of surface water; opportunity to assess pathways
- Highly fractured rock below break in slope may facilitate infiltration
- Examine the character of transition between Cerros del Rio basalts (R-9, R-12, R-13, R-14) and dacitic lavas (R-15)

UNCLASSIFIED

R-11 Drilling and Well Completion

- Open borehole using air with minimal fluids
- Core the upper portion of the borehole to auger refusal or 250 ft max.
- One screened interval in the regional aquifer

UNCLASSIFIED

Potrillo Canyon: Well R-18

- R-18 was proposed to provide information on presence, occurrence and quality of perched zones, and depth to regional aquifer in poorly understood part of the Lab.
- Due to access, R-18 cannot be drilled where it was shown in the Hydrogeologic Workplan; alternate locations do not have significant characterization value.
- Propose relocation to Potrillo Canyon, where R-32 was originally planned.

UNCLASSIFIED

Cañon de Valle: Well R-26

- Water quality in an area upgradient of all releases from Laboratory operations
- Effect of the Pajarito fault on groundwater flow
- Presence or absence of a perching horizon similar to what is present at R-25
- Water-level, aquifer characteristics, and chemistry data in the recharge area for improving the regional flow and transport model
- Proposed location: between Ancho Ranch Road and West Jemez Road

UNCLASSIFIED

R-26 Drilling and Well Completion

- Air with minimal fluids
- Core the upper 200-foot portion of the borehole
- Two screened intervals: one in the perched zone (if present) and one in the regional aquifer
- Total depth will be about 1500 ft and will penetrate about 100 feet into the regional aquifer

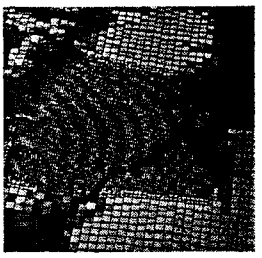
UNCLASSIFIED

R-Wells Data Collection

Data Needed	Data Collection
Stratigraphy	Core, cuttings, and geophysical logs
Perched zone identification	Driller observations, borehole video, drill with minimal fluids
Perched zone water chemistry	Borehole screening sample, if encountered
Contaminant distribution in vadose zone	Core in upper portion; cuttings for sorbing species
Regional aquifer water level	Measure water level in borehole and well
Regional aquifer water chemistry	Collect water samples from well
Regional aquifer hydraulic characteristics	Hydrologic testing

UNCLASSIFIED

FY03 Non-Field Activities



- **Information Management**
- **Groundwater Pathways Assessment**
- **Regional aquifer modeling**
- **Geologic Model**
- **Quarterly and Annual Meetings**
- **Annual Report**

First-Order Groundwater Pathway Assessment: Pieces, Parameters, Products and Path Forward

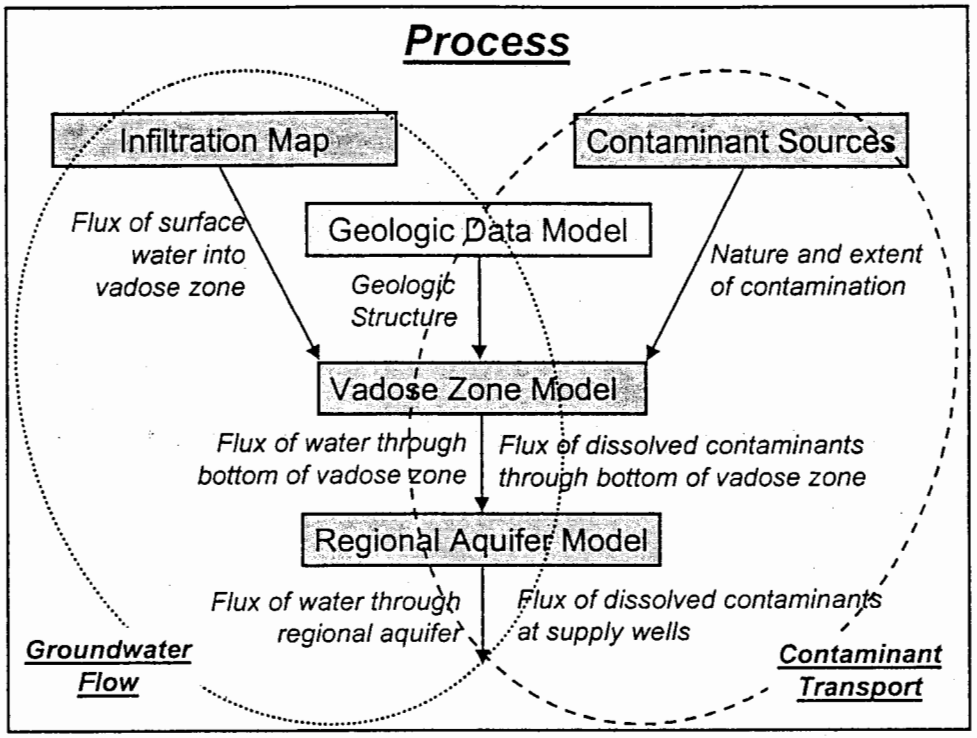
Prepared by Diana Hollis, LANL
Paul Davis, EnviroLogic, Inc.

Work conducted by
Many members of the GIT

January 22, 2003

Pieces

- Infiltration Model (*Ed Kwiklis, Marc Witkowski*)
- Geologic Data Model (*Greg Cole, Bill Carey*)
- Vadose Zone Model (*Kay Birdsell, Bruce Robinson*)
- Saturated Zone/Regional Aquifer Model (*Elizabeth Keating, Monty Vesselenov*)
- Groundwater Contaminant Sources (Leslie Dale, *Pat Longmire, David Rogers, Chris Echohawk, Marc Witkowski, Tom Riggs*)



Parameters: Infiltration Map

- Incorporates many parameters using GIS tools to quantify infiltration across the Pajarito Plateau
  - Precipitation
  - Elevation
  - Topography
  - Elevation
  - Geology
  - Ecotone
  - Subsurface moisture data
  - Stream gage data
  - Runoff measurements
  - Natural tracer data
  - Anthropogenic sources
- GIT Peer Review identified additional data sources, which will be added before final publication

Infiltration Map
(preliminary draft)

Parameters: Vadose Zone Model

- Parameters include
  - Infiltration
  - Saturated hydraulic conductivity
  - Unsaturated hydrologic properties
  - Porosity
  - Bulk Density
  - Moisture content
  - Fracture prevalence
  - Pore size distributions

Parameters: Vadose Zone Model

- Groundwater flux calibrated using measured moisture in the vadose zone
- "Base Case" is the calibrated flow model
- "Fast path" is 3 times the base-case infiltration
  (represents unsaturated flow directly through only Bandelier Tuff into saturated Puye)
- "Slow path" is 1/3 times the base-case infiltration
  (represents unsaturated flow through all strata, including some unsaturated Puye)

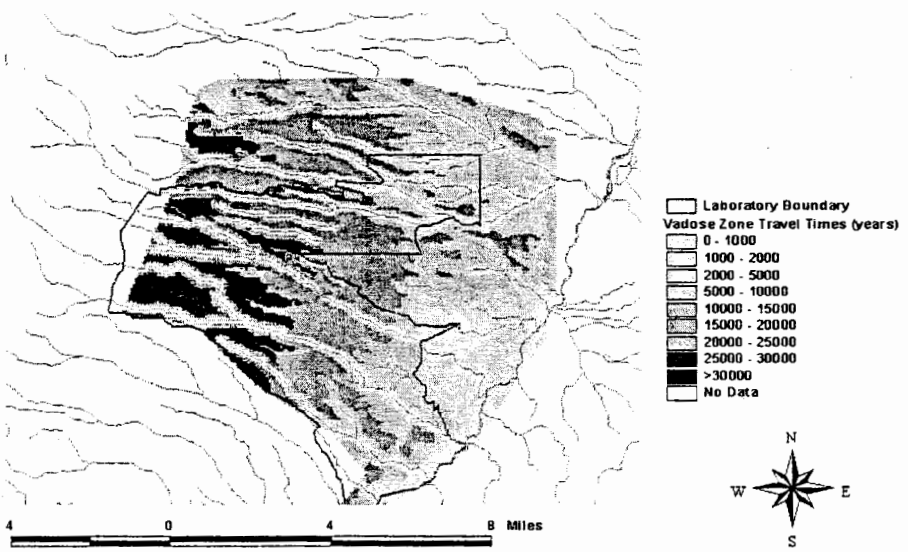
Parameters: Saturated Zone Model

- Parameters include
  - Saturated hydraulic conductivity
  - Effective Porosity
  - Bulk Density
  - Pore size distributions
- Calibrated to measured hydraulic pressures
- "Fast path" uses effective porosity of 0.0001
  (represents preferential flow path)
- "Slow path" uses effective porosity of 0.2
  (represents porous flow)

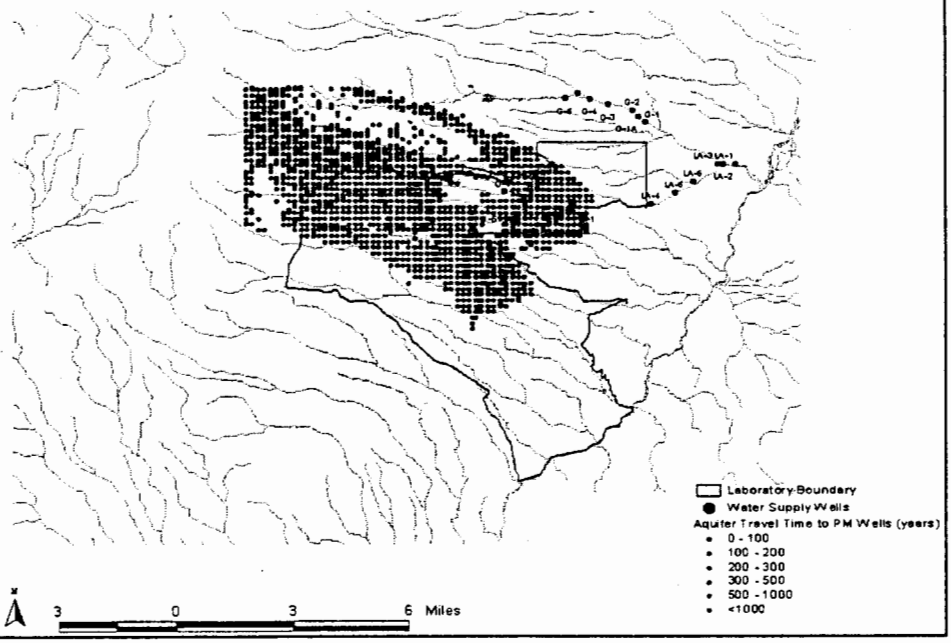
Products

- Travel times from the surface to the bottom of the vadose zone
- Travel times from the bottom of the vadose zone to the nearest supply well
- Flow paths in the regional aquifer toward supply wells

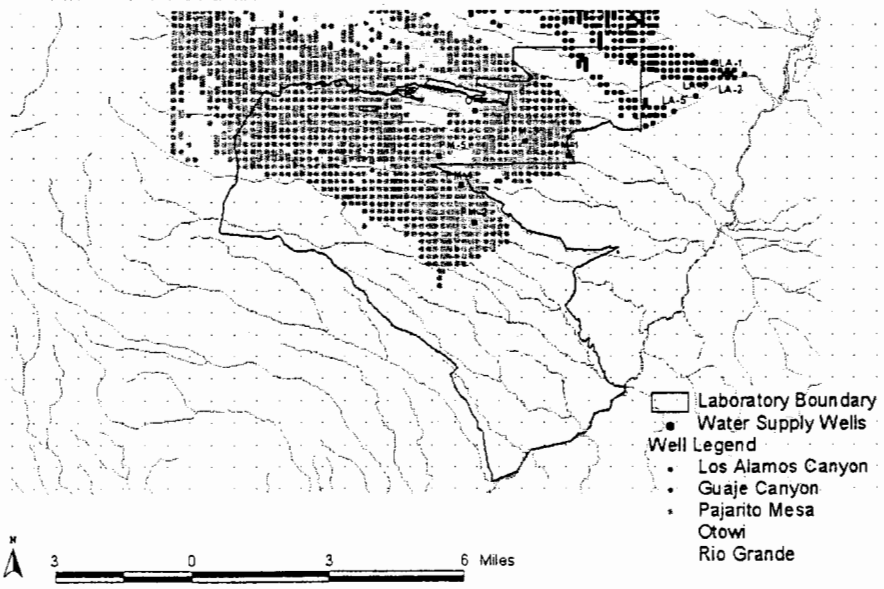
Travel times to base of vadose zone



Travel times from base of VZ to supply wells



Flow paths from base of VZ to supply wells



Products

- High-priority locations based on travel times to nearest pumping wells less than 100 years
  - Mortandad Canyon
  - Water Canyon/Canon de Valle
  - Los Alamos/Pueblo Canyon
  - Sandia Canyon
  - Pajarito Canyon

Products

- Map of contaminants detected in 2002 in alluvial, intermediate and regional groundwater in high priority canyons
- Peer review to be conducted by GIT prior to official release

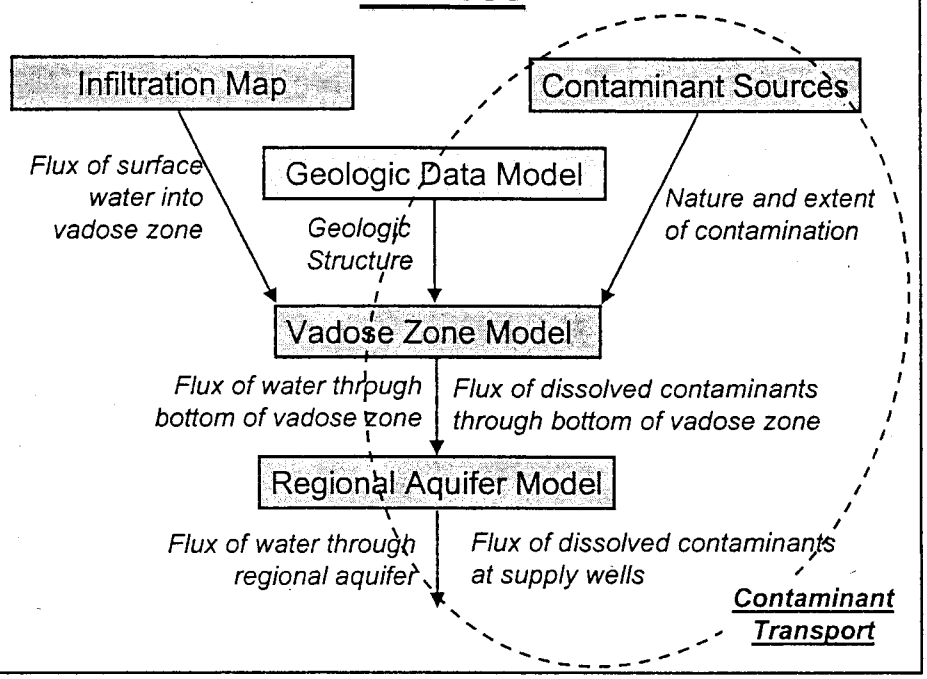
Contaminants Detected in 2002 in Groundwater in High-Priority Canyons

(preliminary draft)

Path Forward

- Identify high-priority *contaminants* in high-priority canyons as those with transport times to supply wells less than 100 years considering
  - Solubility
  - Speciation
  - Sorption
  - Biodegradation
  - Radioactive decay
  - Detections in groundwater

Process



Path Forward

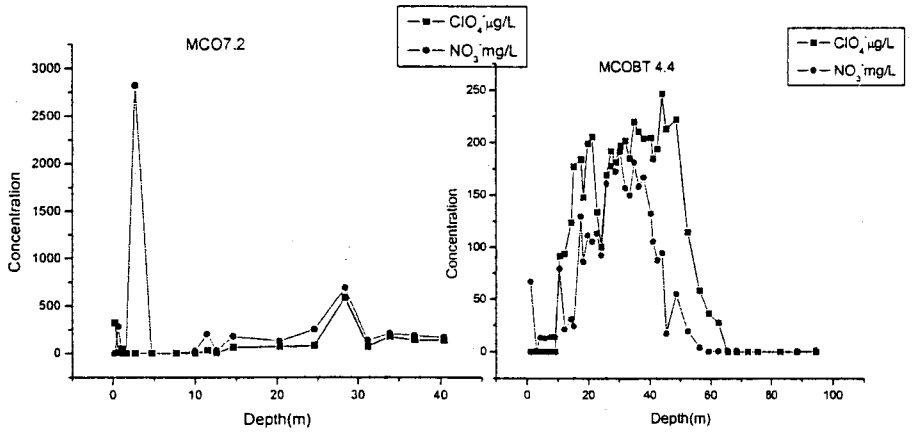
- Calculate flux of high-priority contaminants from source location to capture zones of supply wells for a period of 100 years
- Conduct phased risk assessments according to EPA's *Risk Assessment Guidance for Superfund*

Path Forward

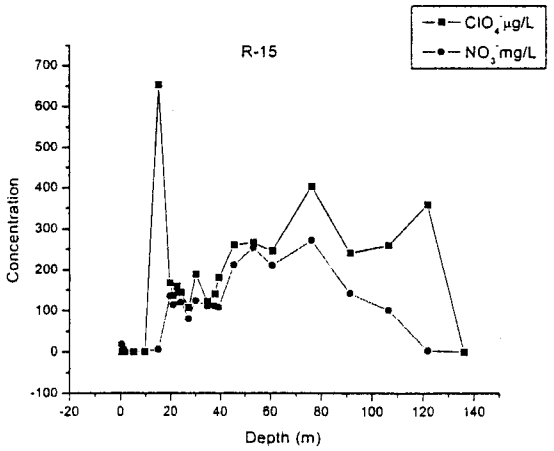
- Calculations under way for Mortandad Canyon
  - Infiltration rates based on map and several site-specific water balance studies (including initial site characterization survey from 1960s)
  - Contaminant inventory estimates based on
    - historical annual discharge records for nitrate, tritium, strontium, cesium, americium, plutonium, and uranium
    - scaling factor for perchlorate based on statistical correlations between nitrate and perchlorate measured in core samples

TA-50 Discharge Records
(Rogers)

Nitrate and Perchlorate Correlations
(Newman and Gard)



Nitrate and Perchlorate Correlations
(Newman and Gard)



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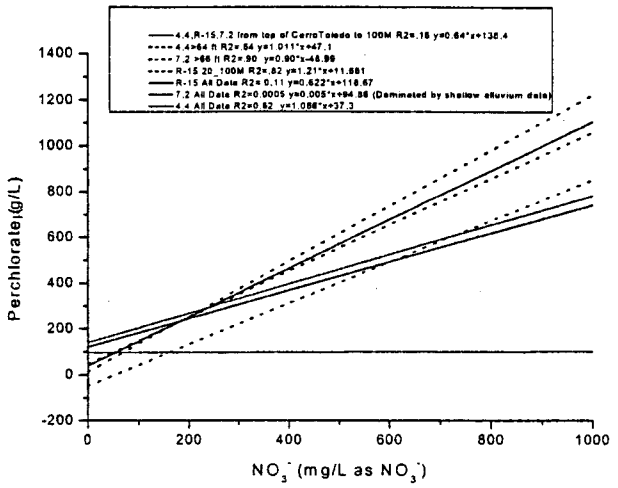
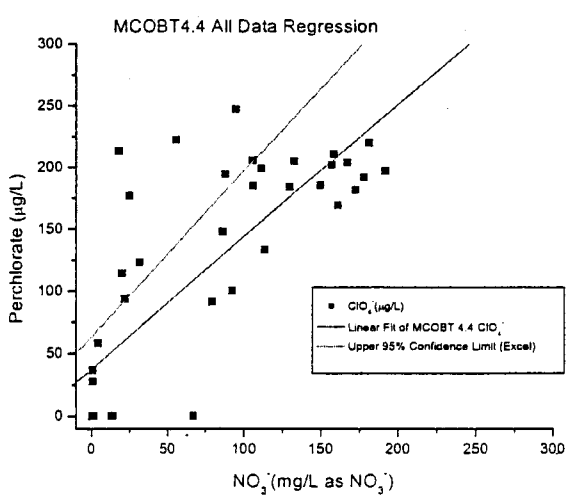


Nitrate and Perchlorate Correlations

(Newman and Gard)



Nitrate and Perchlorate Correlations
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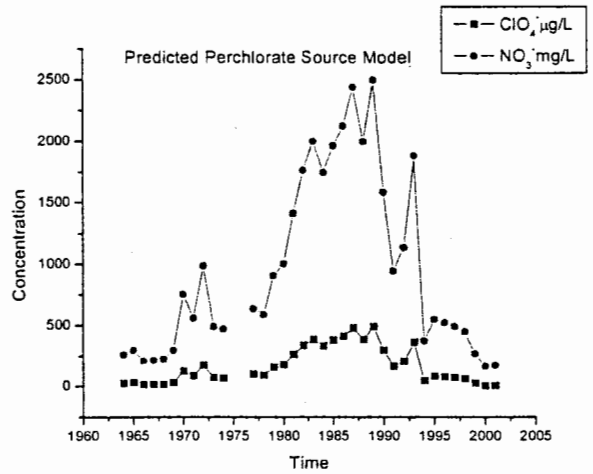

Path Forward

- Transport of high-priority contaminants will be modeled between 1963 (when TA-50 began operations) and 2103 (100 years into the future), with source controls accounted for
  - Nitrate discharge reduction by reverse osmosis system (2000)
  - Perchlorate discharge elimination by anion exchange system (2002)
  - Alluvial groundwater contaminant sorption by permeable reactive barrier (2003)

Path Forward

- Vadose zone transport calculations will be calibrated to core sample data
- Fluxes of high-priority contaminants in capture zone of PM wells will be calculated

Semi-Annual Report
to the
Groundwater Integration Team (GIT)
of the
Los Alamos National Laboratory
by the
External Advisory Group

Meeting dates – 29-31 Oct 2002

External Advisory Group

Elizabeth L. Anderson, Sciences International, Inc.

Robert W. Charles, Consultant, Geochemistry and Management

Charles F. McLane, McLane Environmental, L. L. C.

Robert M. Powell, Powell & Associates Science Services

Jack D. Powers, Consulting Engineer

David C. Schafer, David Schafer and Associates

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EXECUTIVE SUMMARY

The External Advisory Group (EAG) for the Groundwater Integration Team (GIT) of Los Alamos National Laboratory met during the period October 29-31, 2002, in Santa Fe and Los Alamos, New Mexico. The following summarizes our major observations and comments.

Management and Global Issues:

- No progress has been made in defining end-states for the Workplan beyond time and funding.
- The Management Core Team has met, however the impending Corrective Action Order has destroyed operating relationships between LANL and DOE vs. NMED Regulators.
- The EAG recommends the LANL/DOE Management Core Team meet with a narrow focus, at least initially, to establish Workplan end-state goals.
- The EAG recommends the Core Team and the ancillary Technical Team select a chairperson, identify a facilitator to work with the chairperson in meeting planning, develop a charter, and set a schedule for activities.
- We applaud the beginning efforts of the PM and GIT to prepare a draft final report which will help focus the Workplan to an end-state.
- External stakeholders continue to be very positive about their working relationship with the GIT but continue to seek increased access to the flow of information and the decision-making process.

Technical Issues:

- The Water Quality DataBase (WQDB) continues to be a major success.
- LANL GIT (Robinson/Keating, et al) continues to engage in modeling outreach efforts, including modeling education, technical exchange with Stakeholders, and solicitation of input regarding alternative conceptual models.
- The EAG recommends the GIT identify transport parameter data needs to support hydrologic modeling activities, and focus resources, to the extent appropriate, to collect necessary transport parameter data.
- We support plans to begin "inter-well" geochemistry assessments/reports to increase understanding of important areas and better define the overall geochemical conceptual model.
- We recommend giving careful consideration to the geochemical DQOs for each monitoring well to be drilled; consider using drilling methods that would have fewer detrimental impacts on aqueous/contaminant geochemistry when appropriate, even though this approach might be much more expensive during the drilling process.
- We recommend continuing to evaluate the potential for false positives resulting from drilling fluid effects; clearly document and present these instances to the appropriate regulators along with the geochemical explanation of why these are releases of natural materials and not a result of anthropogenic contamination.
- We recommend, to the extent possible, when reporting " surprises" in newly collected geologic data (i.e. discrepancies between expected interface elevations or layer thicknesses and those predicted by the current model), that the GIT should attempt to put the discrepancy in context regarding its anticipated effect on the current understanding of flow system behavior as determined from model simulations.

- Increased flexibility in the drilling approach has resulted in completion of a significant number of wells in just half a year.
- Competitive re-bidding of the consulting/drilling contract should stimulate constructive input from the market place.
- Significant strides have been made in improving and streamlining development procedures for the recent rotary-drilled wells.
- EAG peer review was sought on a recently prepared report on hydrologic testing. We applaud the Laboratory for engaging in this valuable process. Hopefully, the review will result in significant improvements to the report.
- Related to the groundwater pathways assessment:
  - The proposed assessment needs to be described in considerably more detail to allow for adequate peer review and comment. The EAG would benefit from meeting with individuals (Hollis/Davis) involved in the effort.
  - *COPCs* are a part of the assessment and they need to be clearly presented together with available toxicity information. For those constituents that may be lacking toxicity evaluations, a plan needs to be developed for arriving at toxicity characterizations for use in the assessment.
  - Caution should be exercised in linking models that may not be sufficiently developed to make early estimates of risk.
  - The EAG recommends that initial outcomes of the groundwater pathway assessment may best be characterized as screening level assessments.
  - The EAG recommends that the groundwater assessment clearly discuss what receptors and pathways are considered and why others are excluded
  - Benchmarks for judging acceptability of risk need to include not only the acceptable risk range for carcinogens and suspected carcinogens of 10^{-6} to 10^{-4}, but also benchmarks for judging risk associated with non-cancer endpoints, including those for agents such as perchlorate.
  - The use of the very stringent 95th percentile value should be reconsidered in light of information forthcoming from the various modeling efforts.
- The EAG recommends that attention continue to be focused on the potential use of alternative contaminant levels or as termed in the State of New Mexico, alternative abatement standards (ACLs/AASs).

1.0 INTRODUCTION

The Hydrogeologic Workplan (Workplan) describes activities proposed by Los Alamos National Laboratory (LANL) to characterize the hydrogeologic setting beneath the Laboratory, and to enhance the Laboratory's groundwater monitoring program. As stated in Section 1.6 of the Workplan, the language implies a risk-based management approach:

> "The goal of the Strategy [LANL Groundwater Protection Strategy] is to describe a dynamic approach to protecting the groundwater resource from unacceptable impacts resulting from past, present, and future operations."

This protection strategy is "to protect...beneficial uses" including "potable water supply, irrigation, livestock, and wildlife watering." The Workplan states that the "highest priority is the protection of groundwater of the regional aquifer because of its beneficial use as a source of drinking water." The Workplan also states that "the regional aquifer also contributes flow via springs and seeps into New Mexico's surface water, e.g., the Rio Grande, which also has incumbent beneficial uses..."

The original Workplan provides a process for drilling up to 32 deep (aquifer-penetrating) wells and shallower wells as needed, including 51 alluvial wells, to 1) reduce hydrologic uncertainties; 2) reduce stratigraphic and structural uncertainties; 3) detect contamination of the water supply system; and 4) assess the nature and extent of potential contamination of the groundwater. Funding for the program is from Environmental Restoration (ER) and National Nuclear Security Administration (NNSA) Programs, depending upon the location and objectives of the designated well. Since its inception in FY1998, the Program Manager and the Groundwater Integration Team (GIT) have managed the Workplan. An External Advisory Group (EAG) was formed in August 1998. The purpose of the EAG is to function as an independent peer review body, comprised of professionals with education, expertise and experience germane to the Hydrogeologic Workplan activities.

The current document represents the ninth semi-annual report prepared by the EAG based on the meetings held in Santa Fe and Los Alamos on 29-31 October 2002. The EAG heard technical presentations, facilitated Management and Stakeholders meetings, and participated in subsequent discussions with the GIT. The EAG reviewing team consisted of Elizabeth L. Anderson, Robert W. Charles, Charles F. McLane, Robert M. Powell, Jack D. Powers, and David C. Schafer. All participated in the review and the preparation of this document. This report summarizes the discussions, impressions, and recommendations of the EAG as of the date of the meeting. Of course, changes may have occurred since the meeting.

2.0 MANAGEMENT AND GLOBAL ISSUES

2.1 PROGRAM MANAGEMENT

Positives:

- *Formation and convening of a Management Core Team*
- *Program Manager (straightforward approach, integrity, program comprehension)*
- *Formation of a Technical Team to support the Core Team*
- *Accelerated Well Drilling Schedule*

- *Plans for a Draft Final Report*

The definition(s) of end-state is the most daunting remaining task facing management with respect to the Workplan. A recounting of the previous attempts to come to some agreement on this issue was chronicled in the last EAG report. It is sufficient to say that some effort has been put forth, but no product has as yet been forthcoming. Each organization (LANL, DOE, and NMED) has developed their own positions, which have not been successfully mediated across organizational boundaries. More recently, a major disruptive threat has been posed to the Workplan by the Draft Corrective Action Order issued by NMED. A multi-hundred-page NMED draft has been met with a multi-hundred-page response from the Laboratory. These documents, in part, illustrate the differing viewpoints of the two organizations, but by their nature, these documents can do nothing to mediate those differences. A court-imposed end-state may be the result, which neither of the parties desires.

Recommendation:

- *The EAG recommends the Core Team and the ancillary Technical Team select a chairperson, identify a facilitator to work with the chairperson in meeting planning, develop a charter, and set a schedule for activities.*

The formation *and meeting* of a Management Core Team over the last six months is a positive step. The leadership of Mat Johansen in this regard is noted. Membership currently is Beverly Ramsey, Scott Gibbs, Mat Johansen, Joe Vozella, James Bearzi, and Greg Lewis. These actions represent attainment of soft objectives and the EAG hopes that the Core Team will move toward substantive achievement. The Core Team has developed objectives well beyond the scope of the Workplan. These include an accelerated cleanup schedule and possible overall reaction to a Corrective Action Order. Our comments will reflect Core Team activities that impact the Workplan. We hope they will focus on this more defined activity for the near future.

Concurrently, a Technical Team (Nylander, Whitacre, McCann, Enz, Cobrain, Young, Broxton, and Cooper), focused more at the front-line working level of the Workplan, has been formed to provide technical advice for management use.

The EAG was disappointed to find that NMED's participation in Core Team activities has been limited thus far. The EAG endorses the plan of the LANL and DOE management to continue negotiating desired end points for the Workplan as well as other activities. The NMED representatives may feel awkward with formulation of end-state policy, but may feel more comfortable in commenting on proposed results. In any case, the EAG understands that NMED is welcome and can participate when they wish in the future. This would be beneficial, as negotiations are made more difficult when one of the parties is unwilling to participate due to the legal implications of the Draft Corrective Action Order.

As the Workplan is entering the last few years of its existence, we suggest the Core Team clarify goals soon to best utilize available means in the time remaining. In the context of the Workplan, we suggest starting with clarification of the goals as expressed in the original document because this is the only document agreeable to all parties - at least at one time. We recognize there have been many changes since. Not all appear to have been met with wide approval by all of the major parties, which is the contentious issue. A clear set of goals will be important in guiding these events. We advise the Core Team not to be afraid to make decisions just because conditions are not perfectly known and are going to change, making preliminary decisions obsolete – Act fast, fail fast, adjust fast. Perfection is not possible. Just do the best one can. It is an unfortunate

aspect of some management styles that (supposed) errors are never forgotten while lost opportunities rarely are noticed. More text reinforcing and adding technical directions to these general management observations are presented, particularly, under DQO's below.

Recommendation:

- *The EAG recommends that, for the sake of the Workplan, as well as other facets of the groundwater program, that the organizational responsibilities in RRES be clarified soon.*

The formation of the Risk Reduction and Environmental Stewardship (RRES) Division provides a welcome combination of the Environmental Restoration Program and the management of the Workplan under the same organizational umbrella. We are not entirely clear as to the relationship of the groundwater activities within RRES, but perhaps this will become clearer at a later date. We hope the selection of a permanent Division Leader will occur soon.

The Workplan is designed to be managed in a matrix of program and line at LANL. The EAG recognizes that in a matrix system much of the technical work is done in the Earth and Environmental Sciences Division (to give one example). The relationship among support and technical divisions appears harmonious, productive, and appropriate.

Regarding more program-related activities, the EAG recognizes the great progress in the Well Drilling Schedule this summer. The EAG also supports the efforts of the GIT to begin writing a draft final report. It is our understanding the next annual report will display this effort. This last item will be of some value to the Technical Team and, subsequently, the Core Team.

2.2 MANAGEMENT OF STAKEHOLDER ISSUES

Positives: (From Stakeholders):

- *Database*
- *Technical Staff*
- *Communications with Staff*
- *Accelerated drilling program last summer*
- *The Stakeholders Meeting*
- *Good information coming out of the Program*

The most recent meeting of the EAG with the external stakeholders (i.e. exclusive of LANL and DOE personnel) was held Thursday, 31 October 2002, in Santa Fe. Attendance was stronger than the previous meeting. Attendees included representatives from NMED (non-regulatory), CCNS, CAB, the NM Attorney General's Office, Los Alamos County, and San Ildefonso Pueblo. The body defined issues that were discussed in the first part of the meeting. Then the PM for the Workplan and the GIT were invited to respond to comments from the stakeholders in the second part of the meeting.

The areas of concern were listed from the last meeting and used as a guide for this meeting. Other items were added as they appeared in the discussion.

Core Team: The mission and direction of the Core Team remains unclear to the stakeholders and there was some question about the relationship between the Technical Team and the

management Core Team. They perceive that the Core Team has a mission transcending the Workplan. In addition to the desire for measurable Workplan end-states, the Corrective Action Order, Accelerated Clean-up Plan, and Groundwater Pathways Assessment appear to be added to the Core Team purview. The stakeholders desire some position statement/mission to be published and made public. In particular, it was mentioned that if LANL desires Stakeholder buy-in on the proposed formal decision analysis approach, then LANL should "put it in writing" and ask for public input. Stakeholders also expressed a desire to understand how decisions arising from Workplan data (among other decisions) will be made. The New Mexico AG's office notes that the Workplan is in a legally gray area (in that it appears to be part of the RCRA Permit, but was never subjected to public process) and wonders if the Core Team will pursue how it is affected by the CAO.

The PM stated that the idea of a Core Team was originally from the EAG suggestion that the NMED, Laboratory, and DOE talk together to define characterization. The Core Team did not begin by taking on the initial questions, but adopted a broader scope. It is just a good idea to begin talking. The team developed objectives and turned to a Technical Team for input. The communication is healthy and they (PM and GIT) are not sure where this will lead other than this is an attempt to communicate horizontally and vertically allowing better integration. The PM believes the results will be taken back to the public through meetings. For regulatory changes, the public participation process will be required.

Modeling: Some new members attending the stakeholder's meeting expressed concern over the modeling efforts. One felt that modeling was being used as an effort to skip steps in proceeding to 'No Further Action' decisions on environmentally sensitive questions. Another noted that some of the current GIT were modelers on the Yucca Mountain Project (YMP) and offered the opinion that the modeling efforts on that project in the mid-1990's did not measure up to those of other Laboratories, such as Lawrence Livermore. The New Mexico AG has hired John Bredehoeft as a consultant for advice on modeling efforts, particularly around Area G and expressed frustration at the difficulty in obtaining modeling reports for review. NMED expressed concern about whether there would be canyon modeling or not, and which canyons will be considered in the modeling effort. Wet canyon bottom modeling was of particular concern to some of the attendees.

Nylander stated that the GIT chose not to use an off the shelf groundwater modeling code. They have used a Yucca Mountain Code (finite element heat and mass transport FEHM), which has an extensive pedigree. The software is available at no cost to interested parties, has a rich history of documentation, and is currently being used worldwide. The software can readily be used to build a model but it must be verified and calibrated with fieldwork. LANL has drilled 19 deep wells in the past 5 years, plus there are existing wells. The GIT is not replacing fieldwork with modeling.

General Trust Issues: CCNS and CAB representatives expressed concern over perceived political pressure to weaken the Draft CAO. Concern was also expressed that LANL was spending an 'unlimited' budget to defeat the CAO although some of the stakeholders felt such an order was just and overdue.

The PM stated that, when he worked for the NMED, big enforcement actions required briefing the Governor and congressional offices. Perhaps Secretary Maggiore may not have informed congressional offices of the Order. In any case, the Laboratory is trying very hard to be in compliance with the law. The PM stated that the laboratory did not ask for political assistance.

Well Security/Responsibility: A Los Alamos County representative expressed concern over the general security of Laboratory wells with respect to tampering/sabotage. Several of these wells are located hydraulically upgradient from public drinking water supply well fields. The County was concerned that they would be responsible for any investigation and cleanup in the event of an incident.

The PM stated that there were discussions last summer about a safeguards and security plan for characterization wells. During construction there have been actions taken to help security when the site is unoccupied. This consists of covering wells with steel plate and lowering the drill rig on top of it. All wells are to be secured during drilling, and all completed wells are capped and locked. The Laboratory is taking a second look and doing a survey to improve security. There may be more information at the next meeting.

Communication: NMED would like more informal communication from the Laboratory to facilitate an open and ongoing exchange of information and to avoid possible misunderstandings and lost effort.

Nylander agrees that this is a nice concept but is very personality dependent. He pointed out that the data being collected complies with the law and there is a weekly e-mail and periodic calls to transmit information to NMED. LANL has noted that the NMED responses are often not timely. The PM feels LANL is taking every legal step and beyond. The Core and Technical Teams could be part of the resolution of these communication issues.

Stakeholder's Meeting: While happy with the meeting, the stakeholders present expressed concern over the low attendance. They mentioned that public interest might be low in the absence of any recent news-generating environmental issues at the Laboratory. Perhaps more widely distributed announcements of the meeting would help to strengthen attendance. The PM will keep trying to increase attendance but pointed out that the absence of news-generating environmental issues is a positive, not a negative thing.

Coring Technologies: NMED expressed concern over the coring technology used in wet canyons and wondered if LANL had consulted industry for the best methods. Several EAG representatives expressed faith in current coring efforts given the institutional and geological settings. Concerning the acquisition of more core, the PM stated that the original Workplan goals were optimistic due to the, then unknown, difficulty of coring in some of the strata encountered.

Low Detects: Low detects, commonly referred to as 'J' (estimated) values raise a red flag to the stakeholders. These data represent 'hits' near the detection level. A lengthy discussion ensued about measurement methods and hardware, particularly a method some stakeholders perceived to have better sensitivity for perchlorate anion than the method being used by LANL. Some stakeholders feel these data are not being given proper attention by the Laboratory. The discussion highlights the lack of agreement among NMED and Laboratory representatives about the import of such data.

The PM confined his response to perchlorate 'J' values. He stated that across the country, municipalities are also concerned. There is concern about how to remove the contaminant, particularly at such low levels The PM stated that work is underway to develop new analytical methods and new toxicity information for this compound nationally.

Core Disposition: Several of the stakeholders expressed concern over the plan to destroy some of the core obtained under the Workplan due to the lack of storage space. CCNS requested that the EAG look at the core inventory and make recommendations.

The PM stated that all R-well core and older core would be kept. Shallow investigations by ER may be the materials that will be disposed of.

2.3 DATA QUALITY OBJECTIVES

Positives:

- *The Core Team of managers from LANL, NMED, and DOE met in an effort to define the end-state products of the Workplan. Although no definitive end-state decisions were made, the parties at least met for the discourse and have, perhaps, developed increased understanding of each organization's position.*
- *The decision by LANL/DOE management to continue the decision-making process for defining Workplan end-states, even in the absence of managerial participation from NMED, is appropriate and necessary.*

The EAG has strongly promoted the defining of end-states for the Workplan, encouraging this process to be carried out by a management Core Team with input from the GIT scientific staff. This section of our previous report delineated our thoughts on the importance of this matter, our rationale for its importance, and gave an example of the types of decisions that might need to be made. Evidently the Core Team did convene with the Workplan end-states as one of the items on its agenda but failed to reach a consensus. This was ostensibly, or at least partially, due to the reticence of the NMED representatives to make commitments to goals not specifically addressed in the recently promulgated Corrective Action Order. The EAG considers this to be an unfortunate occurrence and believes that the representatives should have gone forward to define Workplan end-states, even in the absence of decisions on other issues that might have been on the agenda. This is because the Workplan:

- is in progress,
- is spending significant taxpayer monies,
- was agreed to in writing and developed amongst the parties represented on the management Core Team,
- is intended to serve as a baseline set of site characterization information for further, more refined site assessment and environmental studies, some of which might be in the Corrective Action Order, and
- requires definition of completion to avoid unnecessary studies, make certain that needed data are collected, increase efficiency, and avoid wasted effort, time and money.

Therefore, the EAG promotes the concept that LANL and DOE management should proceed to develop end-state goals for the Workplan. Such bounds will prevent unnecessary expenditure of DOE (and ultimately taxpayer) funds and will also prevent potential delay or insufficient understanding of the LANL subsurface because of the shifting focus of the NMED regulatory agency and the lack of focus of LANL and DOE management during the past several years.

Recommendation:

- *Convene the LANL/DOE Management Core Team and narrow the focus, at least initially, to Workplan end-state goals.*

The EAG initially envisioned the singular goal of our recommendation for formation of a management Core Team to be definition of the Workplan end-states. It appears, however, that the scope of the team was expanded to include activities beyond the Workplan and that little has been accomplished specifically for the Workplan. The inability to accomplish the initial stages of end-state definition are likely due to the diffusion of effort and management will-power upon seeing an agenda loaded with numerous difficult and potentially controversial topics/tasks. Such an agenda almost always dooms a committee from within a single organization, and asking such of an inter-organizational committee only compounds the difficulty. We understand that the Workplan exists within a milieu of other environmental programs, regulatory documents and requirements. However, the goals of the Workplan itself seem relatively straightforward and self-contained, requiring primarily limits on what is to be achieved and the required confidence in those established limits. It should be remembered that a fundamental understanding of the subsurface characteristics at some agreed upon scale, vis-à-vis, the Hydrogeologic Workplan, does not mean that all characterization activities at the site are concluded. It simply means that studies at this scale site-wide are concluded and increased focus and resources can now be applied to areas of more specific concern. Because of this, we ask that the Core Team narrowly focus its initial activities in order that the program can build on its previous solid accomplishments to a successful conclusion.

2.4 ADMINISTRATIVE

Positives:

- *Management of meeting logistics.*
- *Collection of viewgraphs, notes for prior distribution.*
- *Name tags.*
- *Meeting location.*

The EAG recognizes these positives once again. We are grateful to Suzanne Maez for her help with the logistics of the meeting. The compilation of the view graphs and abstracts was very helpful to the EAG. It is really a pleasure to collect the notes written on the document and be able to reconstruct meeting events. The EAG thanks Suzanne Maez, Kelly Bitner and the GIT for their efforts here. We thank Kelly Bitner, particularly, for recording the stakeholder minutes.

Recommendation:

- *The EAG would like one-on-one time with technical staff as part of the meeting with agenda items designed beforehand of mutual interest. Suggest this be ½ day with EAG splitting out to meet with individuals*

The group meetings of the EAG with the GIT have had some positive effects in communication. One example is the discussion of a draft final report. The EAG desires the opportunity to talk one-on-one with GIT members at the next meeting with some agenda items planned before the meeting. Perhaps the group vs. individual meetings could be alternated if both are not possible at any one meeting.

Recommendation:

- *It appears that a chairperson/timekeeper should be instituted to keep technical presentations within the time allotted in the meeting schedule and to allow sufficient time for questions and comments.*

The general enthusiasm and perhaps lack of preparation by some of the presenters caused the technical program at the recent meeting to greatly overrun. In some cases the overrun caused postponement until the next day for some of the technical presentations. In these cases much of the audience was lost.

3.0 TECHNICAL ISSUES

3.1 DATA GATHERING AND DATABASE

Positives:

- *Continuing the development of consistent data formats and standard units of measure for the WQDB.*
- *Movement to integrate groundwater data management across LANL organizations.*
- *Developing improvements in the methods for updating data.*
- *Development of common DB architecture with NMED and program for NMED data input.*
- *Continuing integration of ER data into the WQDB.*
- *Successful transfer of all R well data onto the website.*
- *Development of consistent web interfaces for all important aspects of interacting with the WQDB.*
- *Migration of the external version of the WQDB to a more capable server.*
- *Collection of data continues even in the absence of definitive Workplan end-states, thanks to the dedication of GIT scientists. –This is reiterated from the last report but remains important to NMED.*

The WQDB continues to be a stellar aspect of the Workplan. It seems to be well thought out with respect to its design and the implementation of the design is organized and carried out in appropriate sequences and in a timely manner.

It is very encouraging that LANL is endeavoring to create an approach to groundwater issues that integrates across the various LANL organizations. This should result in a comprehensive database for easy access to the information acquired and an improved understanding of the LANL subsurface. In addition, the incorporation of relevant data from both the NMED and the USGS to the database further increases the likelihood of a comprehensive resource.

Database users and data entry personnel benefit from ease and accuracy of data entry into the database. Anything that reduces the number of required keystrokes enhances the speed with which data incorporation can occur and generally reduces the introduction of errors. Moving the procedures for data entry and verification/validation to a web interface is a very good idea. This is, of course, provided sufficient flexibility for changes, as needed, for the entry/correction process is incorporated into the interface.

The migration of the external version of the WQDB to a more modern UNIX Sun server will hopefully mitigate the issues of slow database response time noted previously by the EAG. It

would be useful for the EAG to be notified when this migration is complete so further observations can be made.

As noted, data gathering is proceeding at an acceptable rate due to the ongoing efforts of the GIT scientists to maintain progress in the absence of well-defined Workplan end-states from the Management Core Team. Comments regarding the efficacy and applicability of these data gathering efforts are addressed in the appropriate specific sections of this report.

Recommendation:

- *It is good that data containerized in the WQDB be formatted in a manner that is consistent regardless of the source of the data. The source of the data (e.g., ER, ESH, NMED, USGS) should be indicated, however.*

All data contained within the WQDB should be standardized in format and with respect to issues such as concentration units. This is true irrespective of the organizational source of the data. The comment was made during the meeting that "This will make it invisible as to which organization the data came from..." Although data formatting differences should not be indicative, this does not mean that there should be no indication of the source of the particular set of data being observed in the WQDB. Instances might arise wherein the source of the data, because of differences in methods and procedures between organizations, might be important, for example statistical analyses of the datasets.

Recommendation:

- *For the various geophysical techniques that are currently being tested for use at LANL, present the preliminary findings in the context of experimental investigation results that will be further evaluated with respect to their reliability and ultimate usefulness to the program.*

At the past several meetings, results of various geophysical techniques have been presented that purport to provide a type of "x-ray vision" view of the subsurface, including zones of saturated water flow, fracture zones, etc. It appears to the EAG that these techniques are in the testing and evaluation stage, and the results are still open to interpretation and not highly reliable at this time. It is recommended that this context be made clear when results of these studies are presented, so that Stakeholders do not place undue emphasis on the implications of some of the findings regarding possible pathways of subsurface water movement.

Recommendation:

- *Actively solicit data exchange with other non-LANL organizations to build relationships with collectors of other relevant data, and to enhance the completeness of the LANL data base at a cost far below that of collecting the data.*

The LANL environmental data base system is being configured to permit data exchange with non-LANL organizations, and LANL is currently engaged in a pilot project of data exchange with NMED. It is recommended that LANL actively solicit the exchange of data with non-LANL organizations (NMED, USGS, surrounding well field operators, etc.), and should commit the resources required for such a program. A program of active data solicitation would have several benefits including the establishment or strengthening of relationships with other organizations regarding site and off-site data and technical issues, and an expansion of the LANL data universe

to areas outside of the Laboratory that might provide valuable information for development and calibration of LANL hydrologic models.

Recommendations Requiring Additional Action: The Information Management Subcommittee indicated during the October meeting that it will continue evaluating means for displaying subsets of data in the database rather than just a single parameter or all of the parameters, as per our recommendations Additionally, they indicated ongoing consideration of our recommendation for some sort of graphical depictions of the data that will not jeopardize security at the laboratory. Accomplishing these goals should be of significant benefit for WQDB users.

3.2 MODELING

3.2.1 Hydrologic Modeling

Positives:

- *LANL GIT continues to engage in modeling outreach efforts, including modeling education, technical exchange with Stakeholders, and solicitation of input regarding alternative conceptual models.*
- *Modeling tools have been developed and data are currently sufficient to perform screening level analyses to calculate ranges of expected results.*

As discussed in the July Quarterly Meeting Notes (September 23, 2002), the GIT continues its commitment to solicit input on alternative conceptual models for ongoing analyses, and to provide more information on modeling to interested parties. A list of five recent modeling publications was distributed as a handout at that meeting.

In addition, work is progressing on the linking of models to be used for the First Order Groundwater Pathways Assessment that will provide information on calculated ground water plumes, travel times, concentrations, and estimates of uncertainty. Information presented at the October meeting indicated that the models for sources, vadose zone, and regional aquifer are ready, and linkages are being developed to produce some initial screening level analyses.

The EAG is encouraged that the modeling effort has progressed to this stage, but has some concerns about the manner in which the pathways assessment will be linked through a risk assessment methodology to a broader decision analysis program. The EAG would benefit from additional information on the programmatic link between the Groundwater Pathways Assessment (as it has been described in previous meetings and in the LANL GIT July Meeting Notes), and the use of the pathways assessment results in the quantitative risk-based formal decision analysis being planned to support Risk-Based Corrective Action and Groundwater Protection Program decisions (as described in the October meeting presentation that bore that title). The recommendation that this linkage be developed and communicated more clearly is presented in the section below. Recommendations regarding the risk assessment aspects of the pathways assessment and decision analysis framework are presented in Section 3.6.

Recommendation:

- *More clearly define (1) the linkage between LANL formal decision analysis and current GIT hydrologic modeling efforts, and (2) the possible application of decisions from this process to current Workplan data collection efforts.*

Over the past year, there have been several presentations describing the use of formal decision analysis (as opposed to sensitivity analysis and uncertainty analysis) to guide decisions regarding the need for either more data, more monitoring, or more corrective action. It is clear that these decisions will be based in large part on the results of modeling. It is not clear to the EAG whether decisions regarding the need for more data (including a specification of the type, amount, and quality of data) will be made in time to influence the current Workplan data collection program, or will possibly require the collection of additional data in a second general phase, or more refined but geographically limited phases, of characterization. The EAG recommends that the GIT clearly define the scope and methodology for the envisioned decision process, its link to hydrologic modeling activities, and the timeframe for decisions arising from the process with respect to ongoing Workplan data collection efforts.

Recommendation:

- *Identify transport parameter data needs to support hydrologic modeling activities, and focus resources, to the extent appropriate, to collect necessary transport parameter data.*

While data are currently being collected for such parameters as lithologic layer boundaries and thicknesses, water levels, and hydraulic conductivity, additional data may be needed for dissolved chemical mass transport parameters such as effective porosity, dispersivity, distribution coefficient, and degradation rate. These data needs should be identified in advance of the critical time of their application in the modeling program, and resources should be committed to compiling available data, developing estimates, and planning and conducting any additional studies that may be required.

3.2.2 Geochemistry and Geochemical Modeling

Positives:

- *Preparation/publication of four new well geochemistry reports.*
- *Ongoing evaluation of drilling fluid effects on well chemistry results.*
- *Plans to begin "inter-well" geochemistry assessments/reports to increase understanding of important areas and better define the overall geochemical conceptual model.*

The Geochemistry Subcommittee continues to evaluate large quantities of data and provide it for use by the scientific and stakeholder communities. The preparation and publication of four new R-Well geochemistry reports is a major accomplishment. The plan to address the geochemistry between boreholes, rather than on an individual well-by-well basis is a good first step in addressing the previous EAG recommendation to "show how the geochemical modeling comes together as a whole for the plateau." This initial integration effort should be especially interesting for those wet canyons in which several wells have been completed.

The continuing and difficult ongoing study of the effects of drilling fluid additives on the groundwater chemistry and the temporal manifestation of such effects is also a very worthwhile effort. This work has shown that these effects can be dramatic and relatively long-lived and supports earlier EAG contentions that substantial alterations in apparent chemical concentrations could result from these materials.

Recommendation:

- *Consider the reasons why bentonite seal materials are impacting the geochemistry of screened intervals in the monitoring wells and take corrective actions where possible.*

Drilling fluids are a concern for developing an accurate understanding of the subsurface geochemistry at LANL, but another issue was also evident during the presentation that is a cause for some concern. Apparently bentonite seal materials are impacting the chemistry of the screened intervals in some of the wells, notably the sulfate values in well R-19, screen #7, and R-22, screen #3. The EAG has previously stated its concern that the sandpack lengths above the screened intervals in the multiple completion Westbay wells are probably insufficient and should be increased. Geochemical data now seem to exist showing that these sandpacks are indeed too short and causing problems. This should be considered and corrected during future well installations.

Recommendation:

- *Give careful consideration to the geochemical DQOs for each monitoring well to be drilled; consider using drilling methods that would have fewer detrimental impacts on aqueous/contaminant geochemistry when appropriate, even though this approach might be much more expensive during the drilling process*

The EAG realizes that drilling conditions on the Pajarito Plateau are extremely difficult, time-consuming and expensive. It must be argued, however, that drilling wells inexpensively and quickly that

1. require increasingly energetic/time-consuming/expensive development procedures to remove entrained drilling materials,
2. alter aqueous chemistry for two to 10 years (based on estimates of drilling fluid degradation rates),
3. might alter aquifer material surface chemistry for an unknown radius around the well bore for an unknown time (e.g., potentially resulting in the reductive precipitation of uranium, much like an in situ remediation around the monitoring well),
4. continue to require expensive periodic analytical suites during the re-equilibration period that might result in data of questionable quality and errors in interpretation,

should perhaps not be considered so inexpensive after all.

For certain canyons, it might be less expensive overall to drill in a more expensive manner and have increased confidence in the chemistry data sooner, rather than having to wait several additional years to attain the needed level of confidence.

Recommendation:

- *Continue to evaluate the potential for false positives resulting from drilling fluid effects; clearly document and present these instances to the appropriate regulators along with the geochemical explanation of why these are releases of natural materials and not a result of anthropogenic contamination.*

The wells where drilling fluids have been used are showing characteristics that might not only confound accurate geochemical understanding and mask the presence of contaminants but also

could actually create the appearance of mobile contaminants where they did not previously exist. For some states and regulatory agencies this could be a cause for concern and, under situations of incomplete understanding or distrust, might result in a move towards enforced remedial actions. An example of this potential includes the elevated concentrations of Ni at well R-9i. The EAG concurs with the conclusion of the Geochemistry Subcommittee that the presence of dissolved Ni was almost certainly the result of the reductive dissolution of ferric oxyhydroxides that are naturally present in the mineral matrix, with the release of adsorbed or otherwise entrained Ni. This same effect could potentially happen with a wide variety of metals and metalloids that are naturally associated with iron mineral phases, thereby increasing the possibility of additional false positives.

Recommendation:

- *For a presentation or publication:*
  1. *Significant figure conventions should be carefully followed.*
  2. *Label dataplot axes consistently.*
  3. *When comparing the same constituents across units (e.g., between two wells) scale the plot for each well to the same maximum values. This makes it easier to see whether values in one well are much lower than in the other, etc.*

For purposes of clarity and understanding, data that are presented should also be scientifically accurate, defensible, and presented in a manner making comparisons as easy as possible to understand. This is true for presentations to regulators as well as public presentations. Although the EAG has no doubt that the geochemical data presented are accurate and reproducible (within the quality available from the wells, etc.), we do wish to add the above recommendation to help with communication issues.

3.2.3 Geologic Modeling

Positives:

- *New geologic data have been incorporated in 3-D geologic model of the Pajarito Plateau.*
- *Use of the 3-D geologic model to try to identify features in the geology that will enhance the hydrologic understanding of the system was stated as one of the primary goals of the geologic modeling.*
- *New information from geologic model (lithologic interface elevations and layer thicknesses) has been transmitted to GIT modeling team for inclusion in recent modeling analyses.*

In the presentation at the October meeting, it was stated that one of the goals of the geologic modeling project was to try to "see things" in the geology that will enhance the hydrologic understanding of the system beneath the Pajarito Plateau. This indicates that the geologic model, which provides detailed information on the location, thickness and geometry of various lithologic units, will also provide a valuable tool upon which to build the hydrologic models that are a major focus of the Workplan efforts.

Recently collected R-Well data have been incorporated in the three-dimensional geologic model and refinements to the depiction of the geology have resulted. The model now is based on approximately 175 borings with geologic picks, and approximately 46 of these penetrate the saturated zone. The Puye formation has been broken out into fanglomerate and pumiceous units;

alternative spatial models have been developed for the deeper basalts; and refinements have been made to unit contacts at several locations in the vadose zone.

During the presentations, several instances were cited in which new data resulted in an adjustment to the elevation of the geologic boundary of one of more units. Because one of the goals of the geologic modeling is to enhance the understanding of the hydrologic system, it is recommended below that new findings of this type be placed in the context of the current hydrologic conceptual model.

Recommendation:

- *To the extent possible when reporting " surprises " in newly collected geologic data (i.e. discrepancies between expected interface elevations or layer thicknesses and those predicted by the current model), the GIT should attempt to put the discrepancy in context regarding its anticipated effect on the current understanding of flow system behavior as determined from model simulations.*

During the recent technical presentations of newly-acquired geologic data, there were several instances in which the predicted elevation of a lithologic contact or predicted layer thickness varied by what appeared to be a substantial amount from the data for that location that was predicted by the current version of the 3-D geologic model. It was difficult for the attendees (technical and non-technical) to determine whether the new data represented a relatively minor refinement to LANL's understanding of the subsurface beneath the Pajarito Plateau, or whether it represented a major change to the modeled geologic structure such that it would dramatically alter hydrologic modeling results that had been previously reported. To the extent possible, it is recommended that announced changes to the geologic model be put in context with respect to anticipated changes in flow directions, travel times, or other results of interest simulated by the hydrologic models.

3.3 DRILLING AND WELL COMPLETION

Positives:

- *Flexibility in drilling approach has resulted in completion of a significant number of wells in just half a year.*
- *Competitive re-bidding of the consulting/drilling contract should stimulate constructive input from the market place. However, LANL should be cognizant of the fact that with a new drilling contractor there may also be a new adjustment period or "learning curve" as the contractor is forced to cope with such things as exceedingly difficult drilling conditions, limited space in the area for setting up a shop/yard, logistical inconveniences in accessing secured areas, periodic forced shutdowns, etc. As much effort as possible should be expended up front to apprise prospective bidders of these conditions and constraints.*
- *Significant strides have been made in improving and streamlining development procedures for the recent rotary-drilled wells.*
- *Completion of a six-inch diameter well (R-21) has been made possible by implementing multiple drilling methods, including rotary drilling. The larger completed well size will help facilitate development and testing.*

Even with a late start in 2002, six regional aquifer wells were completed in just six months. Much of this success can be attributed to the lifting of constraints on the drilling operation. On

the recent wells, the contractors have been free to use casing advance, air rotary with stiff foam, and mud rotary with a variety of drilling fluid additives, on an as needed basis, to get the wells completed. Also, "drilling blind" has been permitted where circulation loss has been particularly severe. With the full arsenal of drilling methods available, it has been easier to overcome the drilling challenges that are encountered frequently on the Pajarito Plateau.

The new drilling approach has proved to be a double-edged sword in that it has created new development problems. Lost circulation encountered during drilling has made it common to lose significant volumes of drilling fluid (up to tens of thousands of gallons) and lost circulation materials during rotary operations. This has resulted in a variety of maladies including:

1. Formation damage (plugging).
2. Persistent turbidity in some wells (probably from the drilling fluid additives).
3. Biodegradation of drilling fluid additives, causing color and odor problems as well as reducing conditions that upset the mineral and groundwater chemistry.
4. Significant development cost increases, while learning how to deal with these new conditions.

Initially, development attempts were costly because of persistent turbidity and the long clean up times involved in completing the wells. Too much time was spent both performing vigorous mechanical agitation and pumping the well with the rig onsite.

Sustained mechanical agitation was unwarranted because vigorous agitation methods, such as surging, only affect the zone immediately around the well bore. They have no effect at a distance from the well, where the source of turbidity is located. Also, vigorous agitation, which is used primarily to unclog the formation pores near the well bore and enhance yield and efficiency, usually accomplishes all it can in a short time. In other words, after a shift or two of surging or other type of vigorous mechanical development, a point of diminishing returns is reached, where further repetition of the procedure has little effect.

Also, an expensive development rig was kept onsite while simply purging wells with a submersible pump in an attempt to minimize the turbidity. Much of the rig cost incurred was unnecessary because it is possible to pump the wells on a sustained basis without the rig onsite. Pumping costs were increased further because the Laboratory was limited to just a single power generator for operating submersible pumps for purging the wells. This caused extra cost from delays associated with the logistics of trying to coordinate development activities.

In recent months, significant improvements have been made in the development approach. The Laboratory has taken steps to limit the rig time spent performing mechanical agitation and move the rig off the site during extended pumping periods. Also, additional pumping and development equipment has been brought on site via a new development contractor. This approach has helped contain development costs while optimizing development results.

Recommendation:

- *Continue to optimize the well development approach. In particular, include the following activities:*

1. *Modify the wire brush tool or brushing technique to limit wire brushing to no more than one shift.*
2. *Any vigorous mechanical agitation method must incorporate fluid removal as part of the process (e.g., bailing and surging, simultaneous water jetting and pumping, etc.).*
3. *Limit vigorous mechanical agitation to just a few shifts.*
4. *If surging and bailing are used, limit the time spent bailing as much as practical.*
5. *Consider and/or evaluate simultaneous pumping and water jetting, as well as alternate water jetting and airlifting, to improve development speed and effectiveness.*
6. *Use chemical additives, on an as needed basis, to enhance development effectiveness and improve yield.*
7. *Use submersible pumps for extensive extraction of groundwater to clean up turbidity and/or chemical problems.*
8. *To minimize cost, set up a system whereby wells can be pumped continuously without a drill rig on site and with minimal supervision (personnel involvement).*
9. *Ensure that adequate development capability is available (e.g., pumps and generators) to keep development operations running smoothly and efficiently.*
10. *In multi-screen wells, continue isolation zone pumping as the final polishing step in the development process.*

Recommendations Requiring Additional Action:

Recommendation 12-00-39 (longer filter pack overlaps). It has previously been recommended that longer filter pack overlaps be incorporated into the well designs to guard against exposing the well screen to the formation or bentonite grout seal. It is not clear to the EAG what the resolution of this recommendation has been. Now, because of the new drilling procedures and greater need for thorough, vigorous well development, the recommendation to provide a greater filter pack reservoir takes on even more importance. This is especially so since it now appears that bentonite materials are impacting the aqueous chemistry of certain well screens (See the Geochemistry and Geochemical Modeling section).

3.4 HYDROLOGY

Positives:

- *A proposal is being considered to conduct an extensive pumping test on municipal well PM-2, while monitoring existing nearby regional aquifer wells, offering the opportunity to obtain good information at reasonable cost.*
- *EAG peer review was sought on a recently prepared report on hydrologic testing. We applaud the Laboratory for engaging in this valuable process. Hopefully, the review will result in numerous improvements to the report.*

The proposed long-term pumping test on PM-2 offers the opportunity to obtain good hydraulic data without incurring additional drilling cost. To maximize the value of the pumping test effort, the EAG has several recommendations:

Recommendation:

- *In addition to monitoring water levels in R-20 and R-32 during the PM-2 pumping test, also monitor water levels in R-21, R-22 and R-23.*

It will be important to obtain data from all wells that might respond to pumping (R-21 and, possibly, R-22) as well as background wells (R-23 and, possibly, R-22). During long-term pumping and recovery tests, background water level fluctuations can overwhelm and mask water level changes caused by pumping. It will be important to collect sufficient data to facilitate an understanding of these background effects.

Recommendation:

- *Conduct a spinner test, or equivalent, on PM-2 if one has not already been performed in the past.*

This will aid in understanding relative permeabilities of the sediments penetrated by PM-2 and may aid in the interpretation of the observed response in the regional aquifer monitoring wells.

Recommendation:

- *Contact the transducer manufacturer to verify the sustained accuracy of the equipment over time.*

Sustained transducer accuracy is vital to successful data collection. Because water level changes are expected to be small, minor transducer drift over time could neutralize efforts to acquire a usable data set.

The EAG had the opportunity to perform a peer review of a recently completed hydrologic testing report. While the EAG has previously offered advice on many facets of the Workplan, this was the first opportunity for input on hydraulic data interpretation. The review revealed a number of shortcomings, which have been reported on separately. Among them were the following:

1. There were inconsistencies among the text, tables, graphs and figures in the report.
2. The report promoted hydraulic theories at odds with actual groundwater flow principles, and test procedures in conflict with accepted, prudent pumping test practices.
3. Several pumping tests were analyzed using inapplicable (invalid) techniques.
4. Math/software mistakes resulted in order of magnitude errors in all hydraulic conductivity values calculated from slug tests (most of the values appearing in the report).

These items jeopardized the credibility of the document, rendered the report below Laboratory standards, and could have adversely affected the credibility of LANL's overall program. Hopefully, the recommendations made as part of the peer review will contribute to improving the quality of the finished product and make it suitable for publication. Further recommendations for consideration by the GIT are as follows:

Recommendation:

- *Continue the valuable practice of eliciting peer review.*

The review of the recent hydrologic testing report highlights the importance and value of the peer review process.

Recommendation:

- *Test all screened intervals in multi-screen wells, including the uppermost screen interval that straddles the water table.*

The hydrologic testing report indicated that injection testing was inappropriate for screened intervals that straddle the water table. However, usable data can be obtained from such zones and, as such, they should be tested. The comment in the hydrologic testing report may be due to the fact that the increased saturated thickness near the wellbore caused by the rising water table during injection biases the specific capacity of the well, increasing it above what would be produced based on the original, undisturbed saturated thickness. While this, in turn, can bias conductivity values computed from specific capacity, it is possible to compensate for this effect mathematically, thereby improving the conductivity estimate. Furthermore, calculation methods which rely on *water level change over time*, such as time-drawdown and recovery methods, produce valid results that are unaffected by the increased saturated thickness near the wellbore.

Recommendation:

- *Extend the injection (or pumping) period for zones that are sufficiently permeable to be analyzed by methods other than slug test methods.*

Most injection tests referenced in the recent hydrologic testing report were conducted for only a matter of minutes, generally not exceeding half an hour. This is adequate for zones that are sufficiently impermeable to be analyzed using slug test methods (i.e., zones in which the head buildup exceeds several tens of feet or even hundreds of feet). For more permeable zones, however, longer injection or pumping periods will provide more reliable data sets that support more rigorous analysis. In general, injection periods of several hours would be more appropriate than brief tests. Of course, the costs of conducting the tests must be scrutinized. However, in view of the significant setup time involved in gearing up for the tests, the incremental cost of extending each test for a few hours would probably be minor.

Recommendation:

- *Extend the duration of recovery measurements following extensive injection or pumping periods.*

The drawdown or head buildup response in a tested zone can be uneven because of transient effects (flow rate fluctuations, for example) associated with actively pumping or injecting water, making data analysis difficult and/or uncertain. The recovery response on the other hand, is usually smoother and immune to these problems, and, thus, often supports a more reliable analysis of formation conditions. As a rule of thumb, the recovery interval should be between about 50 and 100 percent of the pumping/injection period. (This is only a rough guideline and judgment must be used in deciding when to terminate the data collection. For example, complete stabilization of the water level would dictate terminating the recovery data collection earlier.)

3.5 GROUNDWATER MONITORING

Positives:

- *Routine monitoring of many wells is in progress, with some of the R-wells having been sampled for four rounds.*
- *Sampling suite approach is being utilized*

Little new information was presented to the EAG on groundwater monitoring at the recent meeting other than indicating which wells are being sampled and the numbers of sampling rounds. Routine monitoring seems to be well underway on the completed wells and the sampling suite approach, to avoid unnecessary analyses of constituents impacted by drilling fluid residues, is being used.

Recommendation:

- *Continue to evaluate better and potentially cheaper methods for collecting representative groundwater samples at LANL for use after well equilibration.*

There was no indication or discussion of a move to low-flow rate purging and sampling techniques even though in some cases these have become the standard by which other sampling techniques are being judged (e.g., at a recent meeting on permeable reactive barriers a presenter stated that regulators were requiring passive bag samplers to yield values comparable to low-flow rate sampling before being approved for use). This is probably not a significant concern at this time in many of the wells because the impacts of the drilling fluids are probably influencing the aqueous chemistry and sample quality more than the sampling techniques. Seeking ways to improve sampling will be of greater concern when the wells re-equilibrate with the formation. The EAG was also not apprised of whether progress was being made on the collection of sensitive, but geochemically important, parameters (Eh, DO, etc.) from the Westbay systems. We assume that the GIT is still continuing its efforts in this area and the EAG would like to request information regarding the status of these efforts.

3.6 RISK ASSESSMENT

Positives:

- *A practical, risk-based rationale is emerging to guide the various modeling and data collection activities; the focus has sharpened to address those issues that are most important to the mission of the Workplan.*

- *Collaboration amongst the various GIT activities to meet the risk-based objectives of the Hydrogeologic Workplan is becoming more apparent.*

In the last EAG Report, the emphasis on a risk-based approach for implementing the Hydrogeologic Workplan and determining final decision goals was discussed in some detail. While this discussion will not be repeated here, the EAG emphasizes the importance of continuing to develop the Workplan and completion goals in keeping with these earlier recommendations. While some progress has been made, a risk-based approach and risk-based goals have not been clearly articulated. The previous recommendations focus on a risk-based approach to guide the practical outcome of characterization effort from the various GIT committees to adequately address groundwater issues associated with the LANL operations

including estimated arrival times to protect against any potential, unacceptable impact on recharge to the Rio Grande or contaminant migration to supply wells.

To clarify earlier recommendations, it has not been the intent of the EAG to force premature probabilistic risk assessment calculations; rather, the emphasis has been on using risk-based decision criteria to guide the characterization efforts. For example, models can be very useful from a regulatory standpoint, as it is generally not possible to rely on monitoring alone to adequately determine long term exposure for receptors at any site that may pose a contamination problem. The development of the various models for characterizing the groundwater at LANL, if focused on risk-based goals, will seek to use a sensitivity analysis to provide a quantitative ranking of the model inputs based on their relative contribution to model output variability and uncertainty. With a risk-based decision rationale as a departure point, it becomes inherent in each part of the effort of the Hydrogeologic Workplan to work toward practical risk-based decision goals. This process can generally aid in focusing the efforts to complete the Workplan within budget, on a timely schedule, and to meet its intended objectives of characterizing the groundwater underlying the LANL facility.

The EAG is pleased to see that risk-based concepts are more frequently being used to assist in guiding the current characterization efforts toward completion of the Workplan. The GIT is also to be commended for not only more practically focusing each independent committee effort but also for moving toward integration of the various studies underway including monitoring, geochemistry, geology, vadose zone characterization, and groundwater modeling toward a final integrated product. In addition to all previous recommendations, which remain current, the following recommendations are added.

Recommendation:

- *Related to the groundwater pathways assessment as described by the Risk Based Protective Action and Risk Based Corrective Action and Protective Strategy:*

a) *The proposed assessment needs to be described in considerably more detail to allow for adequate peer review and comment. The EAG would benefit from meeting with individuals involved in the effort.*

Details of the proposed groundwater pathways assessment were not presented nor was there an opportunity to discuss the intended approach. In the past, various meetings have been scheduled but the meetings have not taken place. More exchange is needed if the EAG is going to be in a position to provide adequate review and comment at various stages during the assessment process.

b) *COPCs are a part of the assessment and they need to be clearly presented together with available toxicity information. For those constituents that may be missing toxicity evaluations, a plan needs to be developed for arriving at toxicity characterizations for use in the assessment.*

This point has been made previously but becomes more imperative if the pathways assessment is to go forward.

c) *Caution should be exercised in linking models that may not be sufficiently developed to make early estimates of risk.*

According to the Workplan, the various modeling exercises that are currently underway are at a halfway point in their final development. Ultimately, it is the scientists who are responsible for the various modeling efforts who must determine if their work is sufficiently refined to allow for a sound, defensible use of the models to reliably predict groundwater movement of contaminants with expressions of uncertainty in probabilistic terms. Since a number of different models ultimately will need to be linked, the degree of uncertainty in the final outcome could be large. Caution needs to be exercised not to provide a premature evaluation that might discredit future use of more refined efforts.

d) *The EAG recommends that initial outcomes of the groundwater pathway assessment may best be characterized as screening level assessments.*

The proposed pathway assessment was described as fully compliant with the Risk Assessment Guidance for Superfund sites (RAGs) Volume 3, Part A. However, this is not the case. A screening level assessment is a more appropriate descriptor.

A screening level assessment is characterized by the use of conservative, health protective assumptions and is intended to screen out trivial risk while focusing attention on those risks that might warrant further study. While it may be instructive to provide some preliminary screening and pathway assessment for the site as a whole, this effort might best be characterized as a screening level assessment rather than one that complies completely with RAGs Volume 3, Part A. RAGs Volume 3, Part A clearly states that a deterministic assessment should be performed first and in certain cases, where it is determined to be beneficial, a second tier effort using a quantitative probabilistic analysis may be useful to describe uncertainty and variability.[1]

With the current state of development of the models, deterministic values are probably premature, thus, making it impossible to accurately follow the guidance. However, a screening level assessment could be instructive, if carefully performed to determine even in the broadest range of uncertainty, if it is likely that a risk might exist. Such an evaluation would screen out trivial risk while focusing additional attention on those risks that might be of concern and, therefore, focus further study on those issues that deserve more scrutiny. Further, using appropriate descriptors will not prematurely raise expectations for a more refined outcome than may be possible at this time.

e) *The EAG recommends that the groundwater assessment clearly discuss what receptors and pathways are considered.*

Benchmarks for judging acceptability of risk will need to include a discussion of receptors and pathways. If only the drinking water supply well pathway is to be included, the reasons for the decision should be made clear. Other pathways, including discharge to the Rio Grande, are inherent in the original Workplan language; therefore, a broader consideration of pathways

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[1] Keep in mind that RAGs Volume 3, Part A emphasizes the need to develop the deterministic values of risk under a workplan that must be accepted before proceeding further while the use of probabilistic risk assessment is discussed in some detail as a means to describe parameter uncertainty and model uncertainty, the guidance makes it clear that any expressions of uncertainty follow as an add-on to the risk assessment. See Risk Assessment Guidance for Superfund, Volume 3, Part A, Process for Conducting Probabilistic Risk Assessment at pages i-iv and pages 1-9, 1-17, 1-18, 1-22, 2-1, 2-3, 2-7, and 2-9.

should be discussed in the assessment.

f) Benchmarks for judging acceptability of risk need to include not only the acceptable risk range for carcinogens and suspected carcinogens of 10^{-6} to 10^{-4}, but also benchmarks for judging risk associated with non-cancer endpoints including those for agents such as perchlorate.

g) *The use of the 95th percentile value should be reconsidered in light of information forthcoming from the various modeling efforts.*

Current parameter and model uncertainty may not be sufficiently refined to allow reliable deterministic values or refined expressions of uncertainty. An alternative certainty level, or a target range of certainty levels, should be developed as soon as possible to help to guide the planned modeling efforts.

Recommendation:

- *The EAG recommends that attention continue to be focused on the potential use of alternative contaminant levels or as termed in the State of New Mexico, alternative abatement standards (ACLs/AASs).*

Ultimately it is the combined knowledge derived from modeling and monitoring that will provide the convincing cornerstones to assure groundwater protection at LANL. This successful two-prong approach currently under development within the Workplan could viably support the use of alternative contaminant levels or alternative abatement standards. As confidence in the results of both efforts increase, the utility of ACLs/AASs should continue to be addressed.

Recommendation:

- *The EAG recommends a continued focus on refining the risk-based management objectives of the Workplan on the broad issues of groundwater characterization.*

The more immediate issues of source remediation for particular units that fall under Superfund and RCRA programs, while needing to be integrated, will undoubtedly be assessed from the source material forward to determine appropriate remediation decisions. This is an evaluation definably separate from the Workplan.

There is a clear linkage between source materials from legacy issues and current operations to groundwater characterization, which is the mission of the Workplan. While the two are linked, the EAG continues to stress that attention also needs to be focused on the clear differences between the two. The Workplan's broad mandate is to characterize groundwater underlying the LANL facility to complement the programs engaged in addressing legacy issues, the safety of ongoing operations, and future activities to ensure long term beneficial uses of the groundwater. The mission to manage any currently existing risk from the source forward requires a different evaluation, which is provided for in the EPA RAGs guidance for Superfund sites. These assessments require a forward assessment of source material to ultimate site and off-site movement as a means for determining a unit-by-unit remediation strategy, if needed. The linkage is at the pivotal point where the contamination from individual sites might intercept the groundwater such that long term impacts on the groundwater system from all sources present and future at Los Alamos as a whole, can be responsibly addressed by the Workplan's characterization program.

4.0 REQUEST FOR ADDITONAL INFORMATION

I. The EAG would benefit from additional information on the programmatic link between the Groundwater Pathways Assessment and the use of the pathways assessment results in the quantitative risk-based formal decision analysis being planned to support Risk-Based Corrective Action and Groundwater Protection Program decisions.

II. We request information about the current effectiveness and use of the Westbay systems, especially with respect to the collection of sensitive field parameters.